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Mission Level Mobility Analysis of the U.S. Marine Corps HIMARS Vehicles

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ABSTRACT: The U.S. Army Engineer Research and Development Center (ERDC), Vicksburg, MS, conducted a vehicle mobility analysis for the U.S. Marine Corps (USMC) High Mobility Artillery Rocket System (HIMARS) to identify the different mission profiles the prime transporters (the USMC Medium Tactical Vehicle Replacement (MTVR) and the MK48-14 Logistics Vehicle System (LVS)) may encounter during worldwide deployment. The proposed mission profile evaluation program focused on using computer-based digital terrain and vehicle mobility models to determine the different terrain types the vehicle may encounter while deployed on missions in three representative climatic regions. The predicted mission profiles for the MTVR and LVS, with and without a M1095 trailer, were quantified to determine their relationship to standard mission profile descriptions. The TeleEngineering Toolkit was used to graphically plan and locate the potential HIMARS mission scenarios in the three regions. The NATO Reference Mobility Model (NRMM) was used to predict the mobility performance of the MTVR and LVS over these regions. The Route Analysis Routine was used to determine the fastest routes to the different storage areas based on the selected corridors of operation and on the NRMM vehicle mobility performance predictions. The Mission Severity Rating algorithms were used to quantify the different mission segments for comparison to standard mission levels and to determine the appropriate mission level for the study vehicles for each climatic region. These climatic region conclusions were combined to develop a worldwide mission profile for each vehicle configured with and without a trailer.

Contents

Preface

The study reported herein was conducted by members of the staff of the U.S. Army Engineer Research and Development Center (ERDC), Geotechnical and Structures Laboratory (GSL), Engineering Systems and Materials Division (ESMD), Mobility Systems Branch (MSB), Vicksburg, MS. Sponsor for the project was the United States Marine Corps (USMC), High Mobility Artillery Rocket System (HIMARS), Quantico, VA. Mr. John Powers, Senior Engineer at the USMC HIMARS Program Office, was the point-of-contact for the work conducted and presented in the report. The work was conducted between March and June 2002.

The study was conducted under the general supervision of Dr. David W. Pittman, Acting Director, GSL; Dr. Albert J. Bush III, Chief, ESMD; and Dr. David A. Horner, Chief, MSB. The overall development was accomplished by Messrs. Randolph A. Jones and Richard B. Ahlvin, and Mses. Stephanie J. Price and Flossie N. Ponder, MSB.

Messrs. Jones and Ahlvin and Ms. Price prepared the report.

COL James R. Rowan, EN, was Commander and Executive Director of ERDC, and Dr. James R. Houston was Director.

1 Introduction

Background

The U.S. Army Corps of Engineers (USACE), Engineer Research and Development Center (ERDC) submitted a proposal to the U.S. Marine Corps (USMC), High Mobility Artillery Rocket System (HIMARS) office, Quantico Marine Corps Base, in February 2002 to assist in the evaluation and development of HIMARS mission profiles for worldwide deployment. The USMC vehicles transporting HIMARS are expected to successfully complete missions in a variety of climatic regions around the world. The USMC Medium Tactical Vehicle Replacement (MTVR) and the MK48-14 Logistics Vehicle System (LVS) are the prime transporters for the HIMARS. The proposed mission profile evaluation program focused on using computer-based digital terrain and vehicle mobility models to determine the different terrain types the vehicles may encounter while deployed on missions in three representative climatic regions.

In March 2002, the USMC HIMARS office accepted and funded the ERDC to conduct a vehicle mobility analysis to identify the different mission profiles the USMC HIMARS transport vehicles, with and without a M1095 trailer, may encounter during worldwide deployment. In June 2002, a comprehensive Microsoft PowerPoint presentation was delivered at the Quantico Marine Corps Base, which provided the mission profile evaluation program background, vehicle mobility model and data analysis methods, and conclusions that are presented and discussed in the report herein.

Objective

The objective of this program was to determine the different terrain types, classified as primary and secondary roads, trails and cross-country, which the USMC HIMARS transport vehicles may encounter when performing missions within representative climatic regions where the systems may be deployed. The predicted mission profiles for the MTVR and LVS were also quantified to determine their relationship to standard mission profile descriptions presented in Table 1.

Table 1
Description of Tactical Mission Levels

Tactical Mission Level	Standard Mission Profile Description
On-Road	All on superhighways, primary and secondary roads, and the best tertiary roads and trails
Tactical Support	Level of mobility requiring infrequent off-road operations over selected terrain with the preponderance of movement on primary and secondary roads
Tactical Standard	Level of mobility requiring occasional cross-country movement
Tactical High	Level of mobility requiring extensive cross-country operations in the ground-gaining and fire-support environment
High-High	All off-road operation

Scope

Using the TeleEngineering Toolkit for terrain evaluation, the NATO Reference Mobility Model (NRMM) for vehicle mobility predictions, and the Route Analysis Routine (RAR) for routing analysis, the different terrains encountered during simulated missions were reported for each scenario conducted during normal weather and wet weather conditions. The mission profiles were determined for each vehicle while traversing from the Corps Storage Area (CSA) to the Ammunition Transport Point (ATP), from the ATP to the Ammunition Holding Area (AHA), and from the AHA to the Firing Points (FP). The TeleEngineering Toolkit was used to graphically plan and locate the potential HIMARS mission scenarios in three different climatic regions worldwide. The NRMM was used to predict the mobility performance of the MTVR and LVS in these regions. The RAR was used to determine the fastest routes to the different storage areas based on the selected corridors of operation and on the NRMM vehicle mobility performance predictions. The RAR results identified the distance traveled and time spent in the different terrain types while traveling along the predicted routes. The Mission Severity Rating (MSR) algorithms were used to quantify the different mission segments for comparison to standard mission levels and to determine the appropriate mission level for the study vehicles for each climatic region. These climatic region conclusions were combined to develop a worldwide mission profile for each vehicle configured with and without a trailer.

The MTVR, LVS, and M1095 trailer vehicle configurations used in this study are presented in Appendix A along with the associated TeleEngineering Toolkit and NRMM vehicle files.

2 Mobility Model

Introduction

The NRMM is an automated, computerized model that was first developed in the early 1970's (Haley et al. 1979). The NRMM combines many mobility-related technologies into one comprehensive package designed to predict the physically constrained interaction of vehicles operating in an on- and off-road environment. Since its inception, NRMM has been continually updated and expanded as a result of ongoing mobility research and is now in its second release (NRMM II) (Ahlvin and Haley 1992). The most current release is referred to herein as NRMM. NRMM provides the U.S. Army and NATO members with a standard reference for mobility performance evaluations. NRMM has been integrated into many automated tactical, analytical, and war-gaming models to provide the mobility realism based on verified and validated vehicle performance predictions.

Model Overview

NRMM is a physics-based, empirically derived, force-balanced vehicle mobility model. A theoretical maximum tractive force-versus-speed relation is determined from characteristics of the vehicle power train, the ground traction assemblies, and the terrain surface characteristics. Then various resisting factors, which produce impediments to motion, are determined. The sum of these resistances compared with the tractive force-versus-speed relation provides a maximum possible force-controlled speed as shown in Figure 1. Several non-force-related speed limits are determined such as ride dynamics, visibility, and braking. The minimum of these speeds and the force-controlled speed are compared to yield a final steady-state maximum vehicle running speed. The vehicle running speed is then considered in conjunction with the frequency of occurrence of individual terrain elements within a given area to provide a final 'speed made good' over a section of road or off-road terrain.

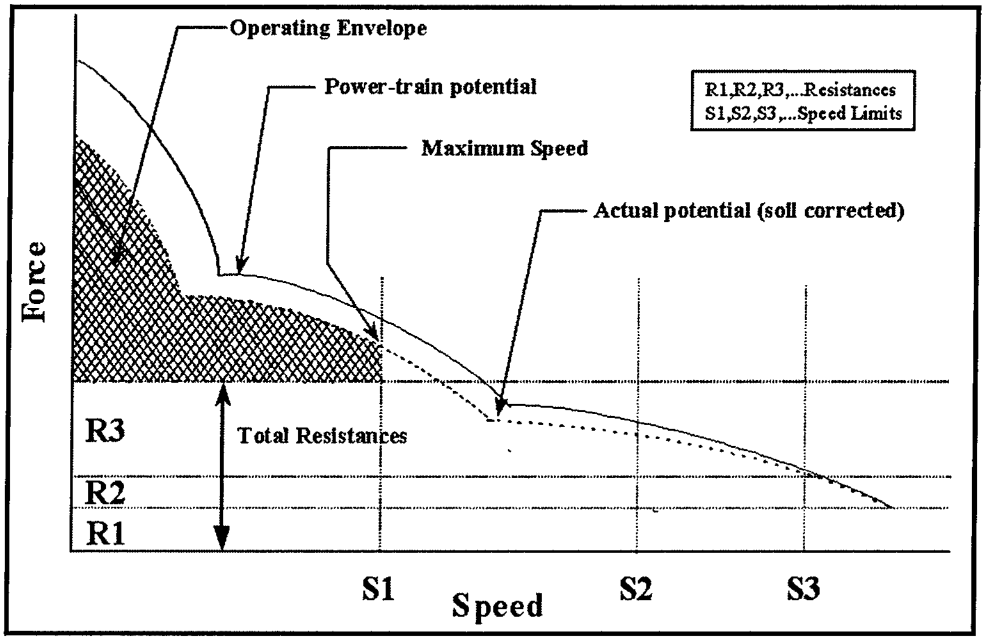

Figure 1. Example of NRMM force-balanced speed prediction

Model Components

NRMM is comprised of several submodels. Each submodel contributes to some aspect of ground mobility performance and, in many cases, has been developed as a result of scientific laboratory and field studies. Many of the submodels are empirical while others are theoretical. A study specifically designed to validate the comprehensive model resulting from the logical combining of these submodels has been performed (Schreiner and Willoughby 1976). Since its inception, NRMM has been further validated by the continual ongoing vehicle mobility studies occurring at the ERDC, U.S. Army facilities, and in the NATO countries. The model consists of the following major submodels: a submodel to predict the power-train performance, a vehicle/surface interface routine (soils and hard surfaces), a slope effects submodel (lateral and longitudinal), an obstacle-geometry/vehicle interface submodel (macro-geometry), a ride dynamics response submodel (micro-geometry), a vehicle/vegetation interface submodel, a braking performance submodel, a curvature submodel, and a water crossing submodel. Several other routines have minor influence on the overall results.

NRMM Submodels

The power-train submodel predicts the theoretical tractive force versus wheel or track speed from information about the power-train components. The power-train components are an engine (defined by a maximum torque-versus-rpm relation), a transmission consisting of various gear ratios and efficiencies, an optional input torque converter, a final drive, and an effective rolling radius or track drive sprocket pitch. This information is used to convert the torque versus rpm for the drive element to the required force versus speed. Optionally, field test results such as dynamometer tests or other power-train model results may be substituted.

The traction element/surface interface submodel computes the maximum traction available from the terrain or road surface, surface motion resistance, and traction-versus-wheel (or -track) slip relation. There are currently five surface traction and resistance submodels for various surface materials. These are: fine-grained soils, coarse-grained soils, organic soils, hard surfaces (roads), and snow cover. A routine for freezing and thawing soils and deep snow cover is currently under development. This information is combined with the theoretical tractive-force-versus-speed relation from the power-train to produce an actual tractive-force-versus-speed for the vehicle operating on the given surface. This relation is consulted to determine the practical maximum speed for a given resistance.

The slope submodel is an implementation of the classic inclined plane and provides the resistance and traction correction factors for operation on longitudinal slopes. For lateral slopes, various factors are computed to determine predictable operating speeds before vehicle tipping occurs.

The obstacle-crossing submodel provides the maximum and average override force and the minimum clearance obtained when the vehicle negotiates discrete obstacles. The density of the obstacles within the terrain patch is also determined from an input average spacing. These results determine whether the obstacle can be negotiated. If so, the average forces required to cross the obstacle and the maximum speed due to the vertical impact are determined. Vehicle acceleration and braking are assumed for operation between obstacles, with the vehicle accelerating from the (usually slow) obstacle-crossing speed to the (usually faster) between-obstacle speed, and then braking back to the obstacle impact speed limit within the obstacle spacing distance. This provides an overall average obstacle-influenced speed prediction. The obstacle-crossing submodel has traditionally been implemented as a separate process to increase overall model predicting efficiency. Results for a parametric set of obstacle descriptions are determined and passed to the main prediction module in the form of a table. The specific results are interpolated within NRMM from this table. The vertical impact speed limits are processed in a similar manner using a vehicle dynamics analysis. Relations from field test results may be substituted for these model-generated results.

The surface roughness submodel provides the limiting speed defined by human response to a given vibration level due to terrain or road surface roughness. The human response is defined in terms of average vertical power absorbed by the body. The terrain information is defined by a root mean square elevation of the terrain profile, which is filtered to reduce the influence of wavelengths greater than 10 ft. This method is usually implemented as a separate process for which results are obtained for a parametric set of terrain profiles and passed to the main module of NRMM as a table from which specific results are interpolated. Relations derived from field tests or other computer simulations are often substituted for submodel results.

The vegetation-vehicle interface submodel provides the maximum and average forces required to override a set of given stem diameters and vegetation densities. The vegetation information is provided as a distribution of average spacings by stem size. Various combinations of vegetation override and avoidance maneuvers are investigated to determine the optimum override/avoid combination case.

The braking submodel provides the maximum speed limit that the vehicle can operate while capable of making a controlled stop within the given stopping distance. The stopping distance is determined from the minimum of the terrain visibility and the driver's recognition distance.

For on-road operation, the maximum speed limit due to curves is determined from vehicle slipping, sliding, and tipping criteria for a given road curve radius. Optionally, the conservative design criteria from the recommended practices provided by the American Association of State Highway and Transportation Officials (AASHTO) may be used.

The water-crossing submodel provides traction reduction factors based on vehicle buoyancy and hydrodynamic resistance. GO/NOGO criteria are determined from water depth and vehicle fording capabilities.

Other submodels provide aerodynamic resistance, certain tire resistances, maximum tire speed, and other minor potential mobility impediments. A plow resistance submodel is also available, providing the resistance due to plowing with a given blade configuration at a given plow depth.

Postprocessors

There are many NRMM-related postprocessor tools, most of which are specific to certain applications. The traverse analysis program processes a special NRMM II output report and provides statistics and prediction results over a series of terrain units. This simulates a vehicle traversing terrains on a path from one location to another. The acceleration and braking of a vehicle while traversing the path is considered. The acceleration time history from zero to maximum vehicle speed and braking time history from maximum vehicle speed to zero are also available.

The speed profile reporting program reads the output reports from NRMM, combines many inputs, and produces a report of speed profiles and mobility rating speeds. There is an option to produce a spreadsheet-style report of selected items. There is a code to combine and edit NRMM prediction files so that one can produce a prediction based on the best or worst of a set of vehicles. Picking the worst of a set is a first-cut at estimating convoy movement speed. Multiple prediction files may be combined into one file, and items such as titles may be changed. Minimum and/or maximum speed limits may be set. The results are a file identical in format to normal NRMM prediction outputs. There is a map display program to read NRMM prediction output and, in conjunction with a map matrix file, produce a color map plot based on vehicle speeds and NOGO regions.

3 Toolkit

Introduction

The TeleEngineering Operations Center (TEOC) was formed by ERDC in FY97 to provide engineer mission support on civil and environmental engineering issues, with teams of subject matter experts providing requested analyses to field engineer units. The TeleEngineering Toolkit (referred to herein as "Toolkit") was developed to assist subject matter experts in responding to requests for engineering information from field active military engineering units and in the analysis of military engineering problems. Its functionality includes collecting data, organizing data requests, tracking previous analyses, maintaining interoperability with other software, and displaying analyses in a meaningful manner. It provides a standardized geographically referenced product that is interchangeable with a wide variety of software products and suitable for simplistic mapping applications. The Toolkit supports U.S. Geological Survey (USGS) Digital Orthophoto Quadrangle data, National Oceanic and Atmospheric Administration (NOAA) Global Digital Elevation Model (DEM) data, and data products from the National Imagery and Mapping Agency (NIMA). NIMA's data products include Arc second Raster Chart (ARC) Digitized Raster Graphics (ADRG), Compressed ADRG/Controlled Image Base (CADRG/CIB), Digital Nautical Chart (DNC), Digital Topographic Elevation Data (DTED), Digital Topographic Data (DTOP), Feature Foundation Data (FFD), Interim Terrain Data (ITD), Planning Interim Terrain Data (PITD), Urban Vector Map (UVMAP), Vector Interim Terrain Data (VITD), and Vector Map (VMAP) Levels 0 and 1. Brief descriptions, with definitions obtained from the product sources' websites, can be found in Appendix B.

Toolkit Operation

The Toolkit uses a folder/directory structure for storing and organizing imported data. The series of folders storing NIMA/USGS/NOAA data are known as the Data Depot. The analyst gives a meaningful name to the Data Depot for the specific analysis area for which data sets are imported and stored. Data Depots are divided by terrain data type and resolution. Automated utilities are provided in the Toolkit for loading the data.

Within the Toolkit, a folder/directory structure that contains all the information and data for an analysis is called a Project. The analyst is responsible for defining the Project, including its geographic boundaries, terrain data, and security classification. Each Project within the Toolkit has applications associated with it known as Components. Available Components include Documents, Annotate, ASCII Plot, Flood Analysis, GPS Track, Mobility, Overlays, Plot Data, Recon, Route Database, and Tactical.

The Documents component is a tool for organizing, cataloging, and geo-referencing any type of file to a point, line, or area. Annotate component is a graphics tool for the development of geo-referenced annotations on the screen. It allows lines, polygons, and text to be displayed over topographic maps, image maps, or terrain data used by the Toolkit. The ASCII Plot component provides the creation of a special format file to allow plotting special purpose overlays. The Flood Analysis component displays ARC/INFO® grid files produced by a flood prediction model of the Coastal and Hydraulics Laboratory (CHL), ERDC. The Global Positioning System (GPS) Track component connects GPS output to the Toolkit for display. The Mobility component, using the NRMM, gives the user the option to display mobility speed prediction and NOGO overlays generated at ERDC, Geotechnical and Structures Laboratory (GSL). The Overlays component supplies access to Toolkit-supported vector terrain data overlays. Typically, ITD, PITD, and vehicle throughput overlays are provided with the distribution of the Toolkit software. Additionally, overlays of supported data types may be created by the user to meet specific needs. Plot Data allows point locations in Microsoft Excel® and Microsoft Access® files to be plotted in the Toolkit. The Recon component provides automated route reconnaissance utilizing special ERDC-developed hardware. The Route Database component uses postprocessed data from the Recon component. The Tactical component displays unit locations.

The areas of interest for this study included Central Europe, Korea, and Southwest Asia. Because large areas of ITD data were readily available, the Data Depots were located in Germany, Korea, and Iraq. ITD features are based on the detail level in 1:50,000/1:100,000 scale Tactical Terrain Analysis Data Base[1] overlays from which terrain feature attributes are obtained. Figures 2, 3, and 4 show the locations of the Data Depots loaded with available ITD in Germany, Korea, and Iraq, respectively. The geographic extents for the three areas are given in Table 2.

Table 2
Geographic Extents of Areas of Interest

Country	Northeast Corner		Southwest Corner	
	Latitude	Longitude	Latitude	Longitude
Germany	51° 15′ 00″ N	10° 15′ 00″ E	49° 00′ 00″ N	8° 15′ 00″ E
Korea	38° 45′ 60″ N	129° 30′ 00″ E	36° 45′ 00″ N	126° 00′ 00″ E
Iraq	34° 07′ 60″ N	48° 04′ 00″ E	29° 11′ 60″ N	42° 50′ 00″ E

[1] Questions regarding reliability and accuracy of the data should be directed to NIMA's Customer Service at 1-800-455-0899. Other ITD specific questions may be directed to 301-227-5050.

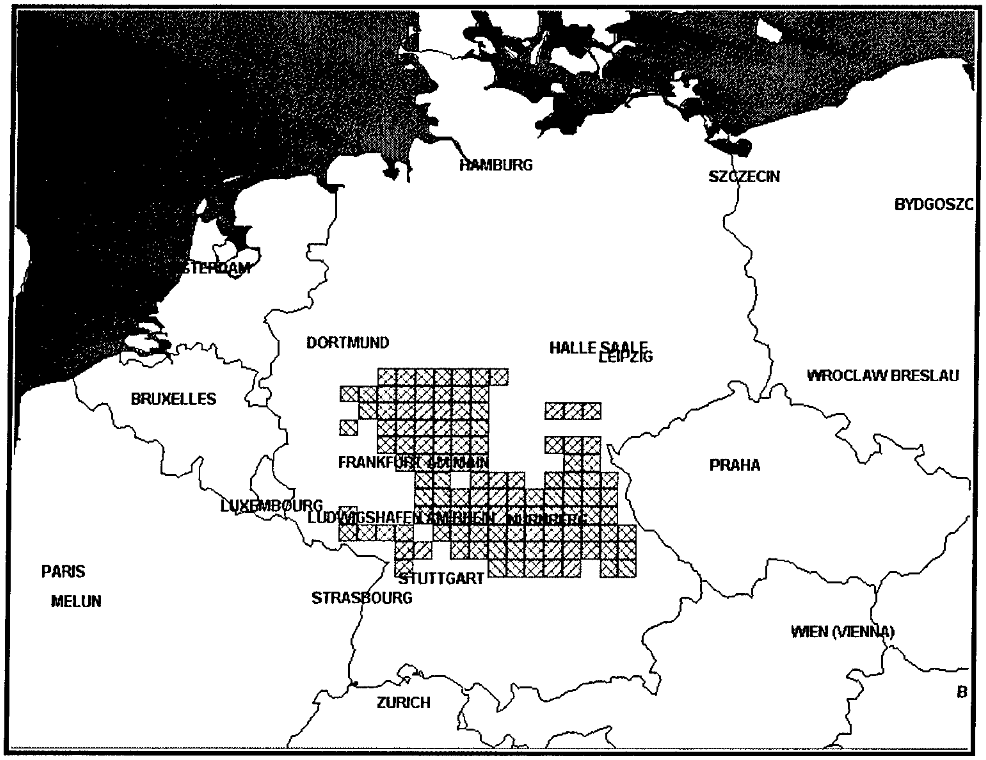

Figure 2. Data Depot ITD coverage of study area in Germany

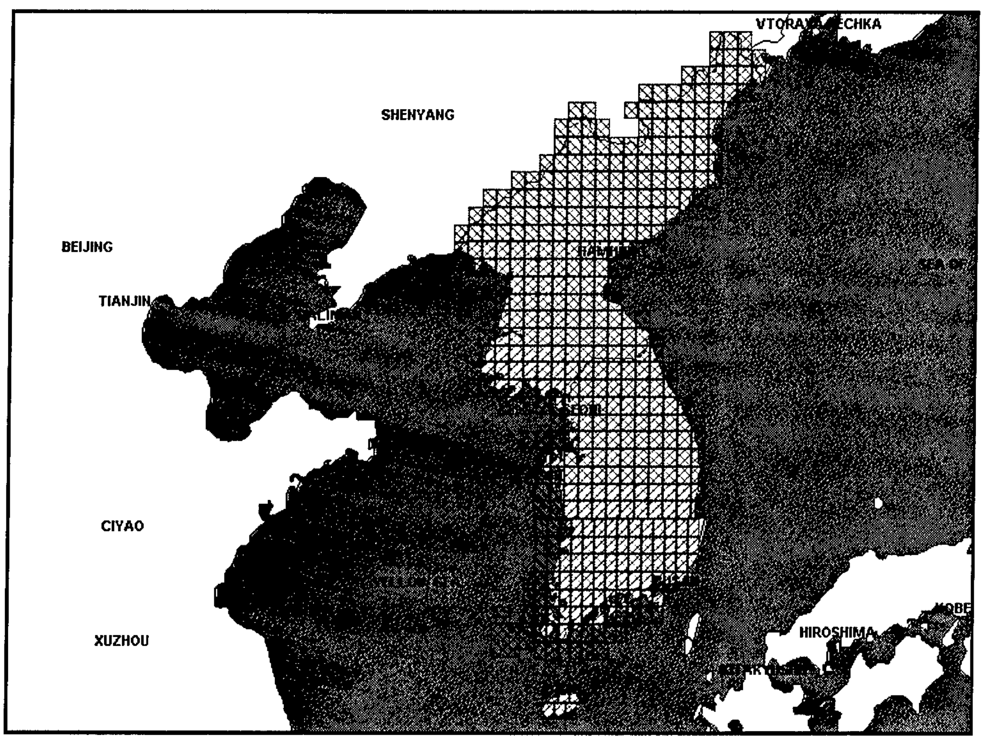

Figure 3. Data Depot ITD coverage of study area in Korea

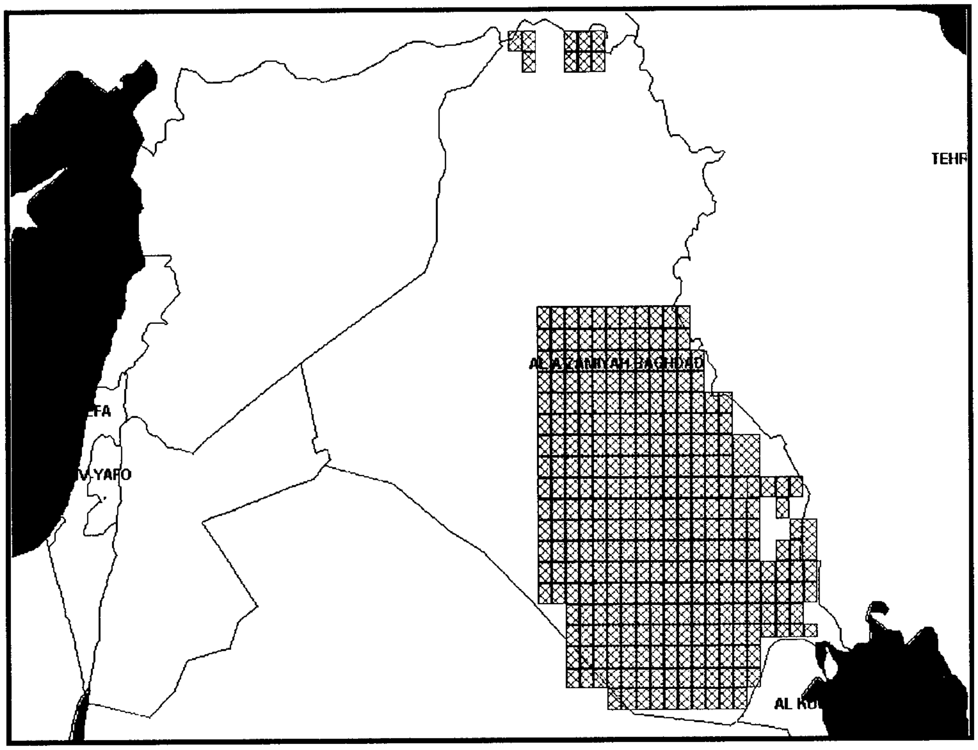

Figure 4. Data Depot ITD coverage of study area in Iraq

The total area of coverage for each region is sufficient for a USMC HIMARS vehicle mission profile analysis, but it should be noted that there are large areas of missing digital terrain within the areas of interest. This missing coverage did not affect the process of creating HIMARS mission scenarios or producing adequate route assessments.

HIMARS Route Planning

In defining the routes to meet the study platform specifications, a reverse mission analysis from the firing points to the established zones of operations for logistical support and operational employment was conducted by military personnel at the ERDC. Reverse mission planning was used to determine the final desired staging areas and firing points for the weapon systems. These areas were then evaluated from a mobility standpoint. The primary alternate and supplementary logistics locations were addressed and backtracked to the initial staging and receiving areas. The first possible routes were determined from the final FP to the possible AHA. Next, the possible routes from the AHA to the ATP were determined, and finally the routes from the ATP to the CSA were defined. These routes were used to render the mobility predictions along the routes created in the Toolkit's Annotate component. Because of software constraints for buffering, each created route segment could not exceed 20 to 30 km in length; thus, one defined study route may actually be created as multiple annotation lines or several route segments.

There were 32 routes defined in Germany, 44 in Korea, and 34 in Iraq. Figures 5, 6, and 7 display all the defined routes over the ADRG data in Germany, Korea, and Iraq, respectively.

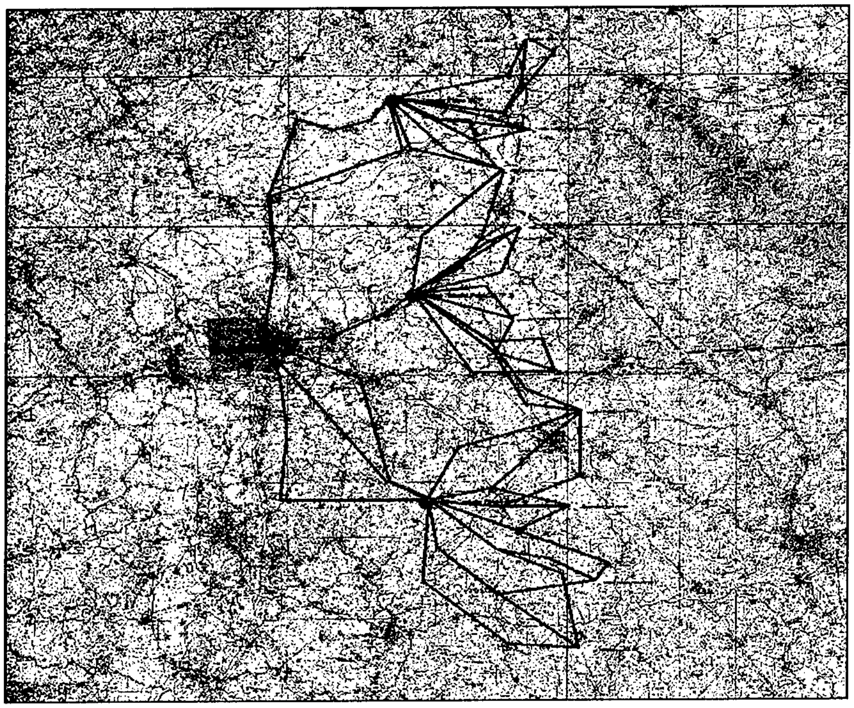

Figure 5. Selected routes from CSA to FP in Germany

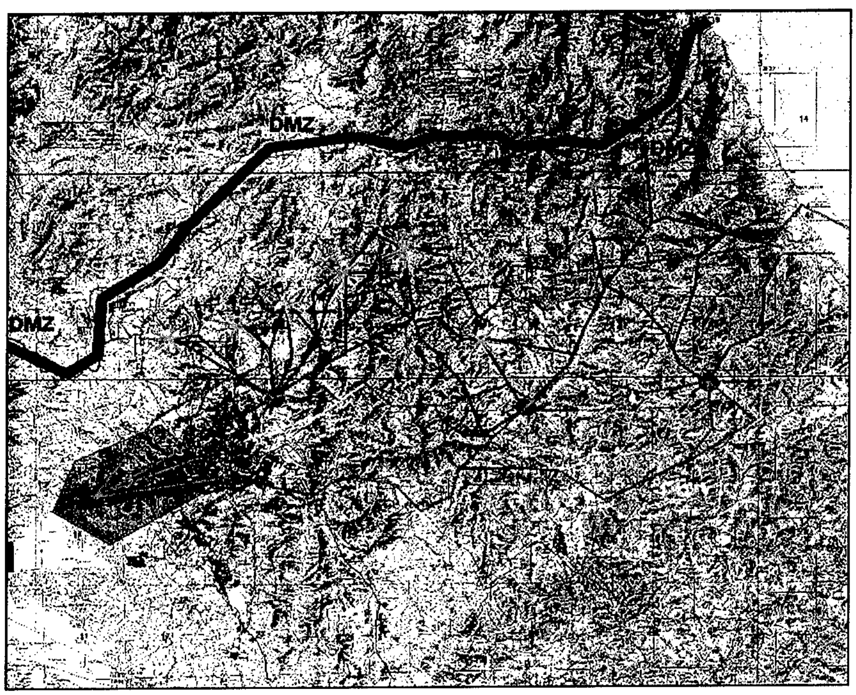

Figure 6. Selected routes from CSA to FP in Korea

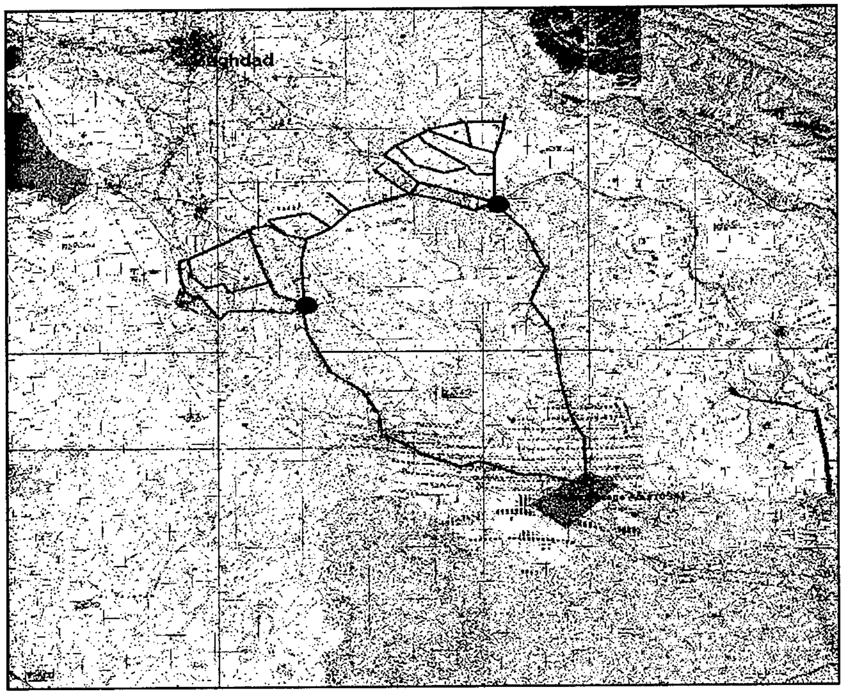

Figure 7. Selected routes from CSA to FP in Iraq

For this study, the Toolkit was modified to create a special-case version (referred to herein as "Route Analysis Routine (RAR)") that included a mobility prediction and route evaluation program. The NRMM was used for creating mobility predictions, and the RAR was implemented to analyze the mobility predictions and take different modes of movement (cross-country, primary roads, secondary roads, trails, bridging assets) for vehicle performance evaluation over a buffered area surrounding the specified routes. The NRMM vehicle mobility predictions are also used for color-coded mobility overlays, as shown in Figure 8, and to assist in predicting vehicle mobility corridors and routes for the terrain of interest. The route buffer allows the RAR to search a 3.5-km area on each side of the route; thus, the best speed paths are determined in a 7-km-wide corridor.

Once the best paths are determined, an overlay showing the calculated path can be viewed like the one shown in Figure 9. The RAR has several options for routing through, over, or around gaps. The corridors for this study were analyzed for routing to the closest bridge and to avoid forced swimming or fording across gaps. The RAR also allows the user to limit the type of terrain available for path selection. The user can eliminate three of the terrain types available for route selection but must eliminate in the order of primary roads, secondary roads, trails, and cross-country. This offers an analysis from lowest mission severity to highest mission severity. In this analysis, all terrain types were available for possible route selection.

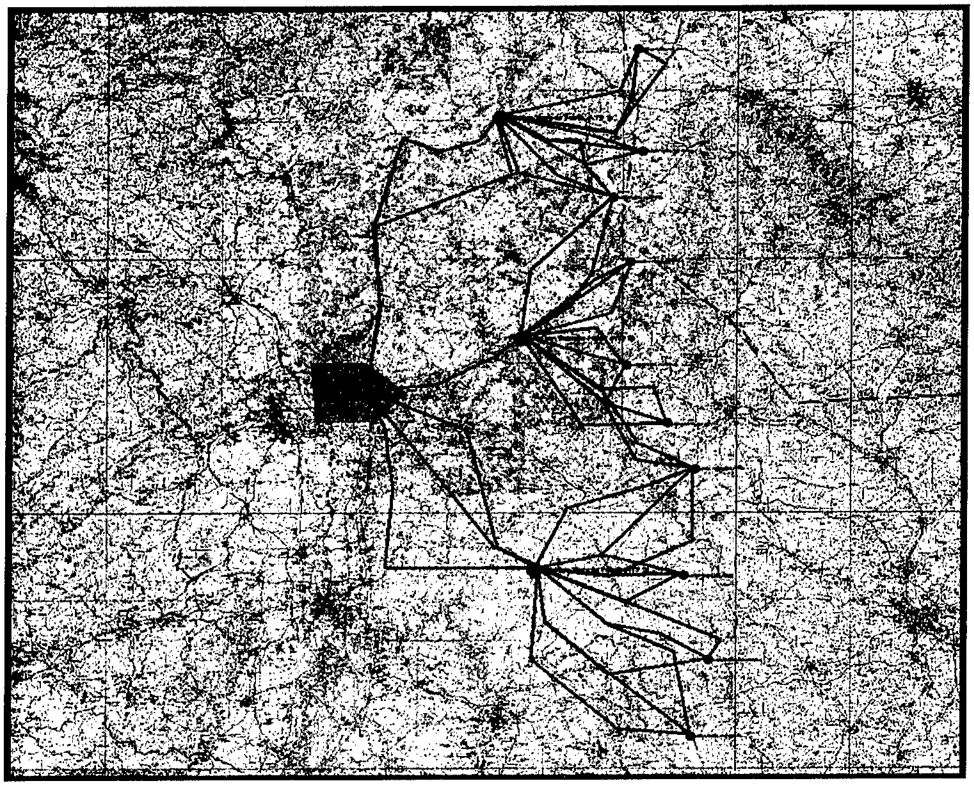

Figure 8. Vehicle mobility overlay from NRMM predictions

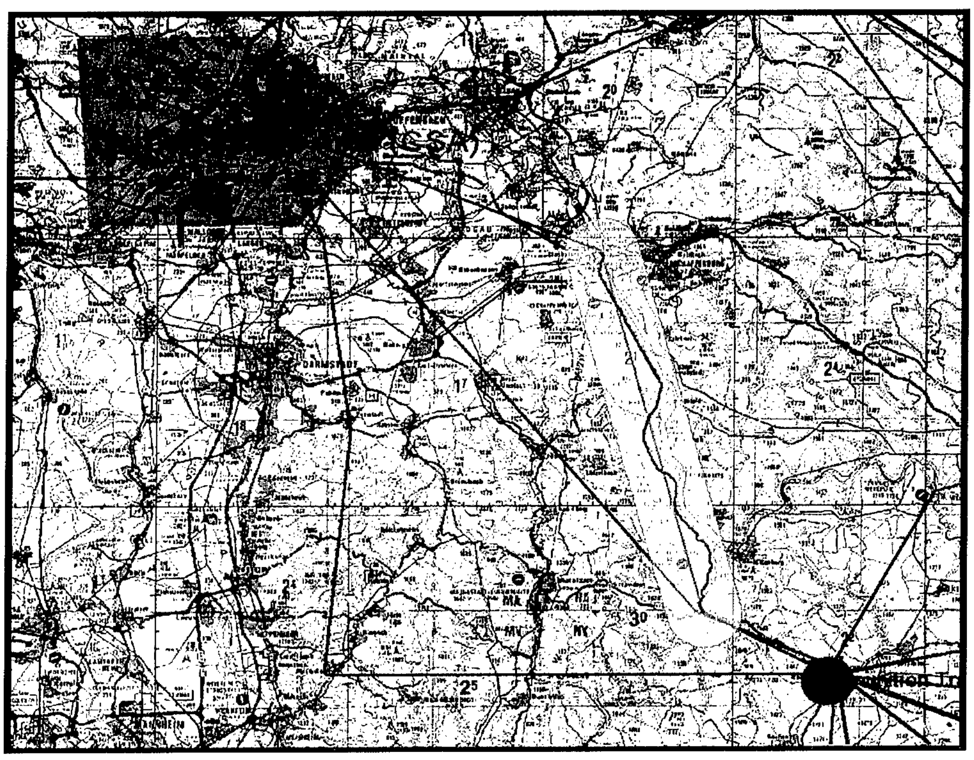

Figure 9. Selected corridor with calculated path

The data presented in Figure 10 are an example of the data output from the RAR. Identifying the columns from left to right, "RTE" is the route under evaluation, "VEH" is the vehicle used in the mobility evaluation, "COND" is the weather condition, "TRV TYPE" is whether the vehicle can span or must ford or swim gaps, "GAP TYPE" is the type of terrain to which vehicle was limited (CPST = cross-country, primary road, secondary road, trails), "STATUS" indicates if the vehicle was able to complete (C) or failed (F) to complete the route, and the time columns are for the different terrain types along with the distance traveled over the different terrains. A terrain-type time or distance of zero does not mean that the RAR did not analyze that type of terrain; it means it was not selected as a viable route or the terrain type did not exist in the corridor of evaluation.

RTE	VEH	COND	TRV TYPE	GAP TYPE	STATUS	NGAP	C TIME	C DIST	T TIME	T DIST	S TIME	S DIST	P TIME	P DIST
1	MK4814	DRY	SPAN	CPST	C	0	129	752	0	0	204	2623	150	2713
1	OSHXLWB	DRY	SPAN	CPST	C	0	59	555	13	196	128	2623	127	2713

Figure 10. Example of RAR data output for analysis

The RAR results were used with the Mission Severity Rating (MSR) to create the ranking of the different HIMARS mission profiles. These results were compared to the U.S. Army Training and Doctrine Command (TRADOC) standard mission profiles. The RAR results were also used to create data plots showing the different percentages of terrains encountered along each chosen corridor.

With the resulting performance data on each route segment for the study vehicle, detailed performance comparisons can be made not only for vehicle-to-vehicle comparisons, but also for component changes on a single vehicle. This level of performance analysis is critical to quickly evaluate a variety of vehicle configurations for performance enhancements and mission affects. Several different missions are typically expected of each vehicle class, but few are evaluated for each different mission profile. The most difficult mission is usually the driving force for durability evaluation and is then used to determine the pass or failure performance of the vehicle, which often forces a higher performance level of vehicle design than required to conduct less severe missions. The evaluation offered by the Toolkit is informative for both vehicle design analysis and for fielded vehicle test and evaluation programs. The Toolkit offers a means for evaluating vehicle performance that answers the mission profile question of "What percentage of each terrain type does the vehicle operate over for this mission scenario?"

4 Mission Severity Rating

Introduction

The Mission Rating Speed (MRS) is a statistical single-mobility performance indicator that may be used to compare and quantify relative performances of vehicles conducting assigned missions over varied terrain types. This indicator considers the ratios of the mission among primary roads, secondary roads, trails, and cross-country. It also includes the relative mobility severity of each terrain type challenged, as a percent of the total area the vehicle was able to traffic within each terrain category. The terrain-challenged performance results are ordered in increasing severity with the vehicle's average velocity over each terrain type being the performance measure. A method of assigning a relative Mission Severity Rating (MSR) index to a mission was developed by the ERDC. This index may be used to quantitatively compare vehicle mission performance among differing missions. The U.S. Army TRADOC has defined several "standard" MRS scenarios to represent various types of military missions. These include Tactical High, Tactical Standard, and Tactical Support mission scenarios.

Often, model studies involve vehicles with a performance and application that do not conveniently fit within these mission scenario definitions and with a relative performance that is not adequately described by these standard scenarios. This is especially true for military vehicles designed for mostly on-road use that have poor off-road performance. Modified or various other mission scenarios are often devised for performance comparison evaluations for these cases. However, it has been difficult to assess relative performance among differing mission scenarios in a meaningful manner. This section describes an improved method of quantitatively describing the relative severity of any given mission scenario. This method was used in the analysis of the USMC HIMARS mission profiles.

Approach

The MRS scenarios are comprised of the percentages of each terrain type encountered in the mission and the challenge level for each terrain. The terrain types are on-road and cross-country. The on-road terrains are broken into subcategories: primary roads, secondary roads, and trails. Composite speed profiles[1] are created for each terrain type. To assess the severity of a given MRS, these data are used to provide a "standard" MRS which is further normalized to the range of 0 to 1, where 1 is the most severe (i.e., all cross-country at the maximum challenge level) and 0 is the least severe (i.e., all primary road at the minimum challenge level.) This resulting "mission severity rating" (MSR) is arbitrarily expressed as a percentage. To simplify the implementation and computation of the MSR, the composite tabular speed profile information was fit to curves chosen by the method of least squares. These functions, their coefficients, and a modified MRS computation comprise the final results.

Composite Speed Profiles

Mobility model predictions using the NATO Reference Mobility Model, Version II (NRMMII) were produced for several military vehicles depicting a wide range of performance over terrain from several varied and militarily interesting areas operating at two scenario environmental conditions. The speed profile statistics information for each of these prediction runs were combined, first by vehicle, then by scenario condition, and finally by map area. The information in Table 3 lists the vehicles used in the MSR development.

Table 3
Vehicles Used in MSR Development

Vehicle	Type	Description	Gross Combination Weight (lb)
M998	4x4	HMMWV (High Mobility Multi-purpose Wheeled Vehicle)	7500
M1025	4x4	HMMWV Armament Carrier	7500[2]
M923	6x6	5-ton Cargo Truck	32500
M977	8x8	HEMTT (Heavy Expanded Mobility Tactical Truck) 10-ton Cargo Truck	60375
M2A2	Tracked	BRADLEY Infantry Fighting Vehicle	66000
M1A2	Tracked	ABRAMS Main Battle Tank	127450

[1] Weight distributed differently than M998.

The weather scenario conditions included were: Dry, Normal fourth quarter and Wet, Slippery second quarter[3]. The map areas included on-road and cross-country transects representative of Central Europe (Lauterbach quad 5322 for cross-country, Shotten quad 5520 for on-road) the Middle East (Mafraq quad

[1] Speed profiles are the relationship of a vehicle's average velocity versus that percent of the total terrain over which the velocity was achieved. The results are ordered by velocity, showing a

[2] Speed profiles are the relationship of a vehicle's average velocity versus that percent of the total terrain over which the velocity was achieved. The results are ordered by velocity, showing a decrease in velocity with increasing severity. Increased terrain severity is assumed to produce greater impediment to mobility and thus lower average speed.

[3] Dry is the average soil strength-moisture condition during the driest 30-day period of an average rainfall year. Wet is the same for the wettest 30-day period. Normal surfaces are the surface moisture condition 6 hr or more after a rainfall. Slippery is the surface condition less than 6 hr after a ½-in. or more rainfall. The quarter of the year is the visibility condition resulting from vegetation during that period.

3254IV for cross-country, Az-Zarqa quad 3254III for primary and secondary roads, Mafraq quad 3254IV for trails) and North Korea (Cheorweon quad 3222III for cross-country and all on-road.). The chart in Figure 11 presents these results.

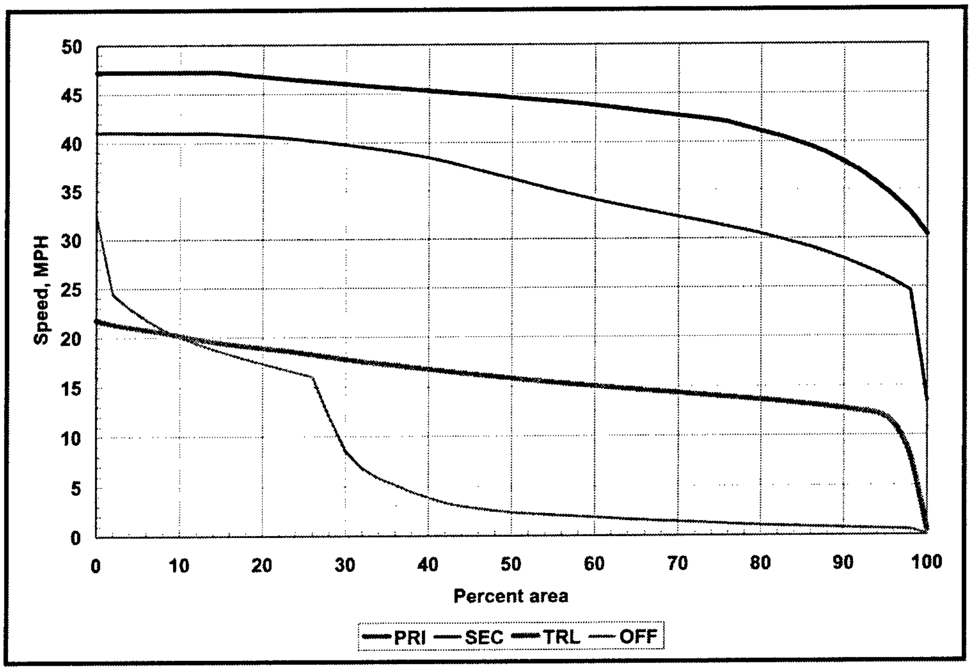

Figure 11. Composite speed profiles used to develop Mission Severity Rating

Composite speed profiles for primary roads, secondary roads, trails, and cross-country traverse were created by combining NRMMII speed profiles for each vehicle, scenario, and mapped area. These were combined on an equally weighted basis. The speeds for these data were normalized to the range of [0,1]. Each speed was divided by the maximum speed for each curve (i.e., the speed at area = 0). These curves were fit to arbitrarily selected functions chosen on the basis of the correlation coefficient, commonality among formulas, and simplicity. Equation 1 was chosen for all on-road (primary roads, secondary roads and trails). Equation 2 was chosen for cross-country. Table 4 lists the coefficients for Equations 1 and 2.

$$S / S_{MAX} = \sqrt{a + bD^2} \tag{1}$$

$$S / S_{MAX} = \left(a + b\sqrt{D}\right)^2 \tag{2}$$

where

a, b = curve fit coefficients

D = challenge level in percent

S / S_{MAX} = resulting speed coefficient

Table 4 **Coefficients for Equations**			
Terrain Type	**a**	**b**	**S_{MAX} (MPH)**
Primary Roads	1.00810431	-4.63466504e-5	47.24
Secondary Roads	0.990241679	-7.1328629e-5	41.04
Trail Roads	0.779061679	-6.48203006e-5	21.73
Cross-Country	1.00000000	-0.095252079	32.43

These raw data and curve-fit result relations are depicted in Figure 12. The final MSR was devised to be similar to the reciprocal of the MRS using the above speed profiles.

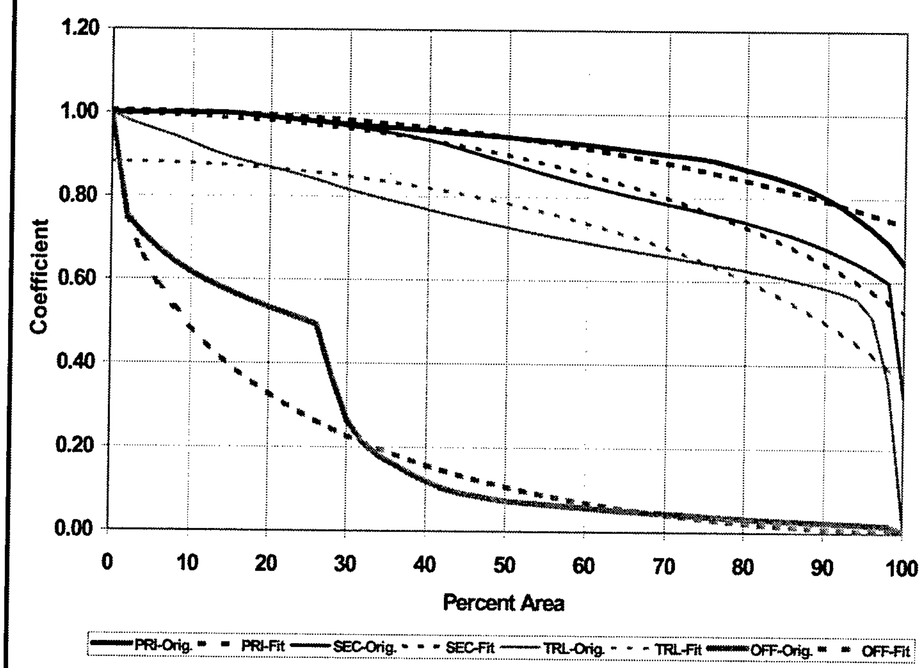

Figure 12. Comparison of normalized NRMM data and curve fit result

The maximum speeds were rounded to the nearest 10 mph shown in Table 5.

Table 5 **Maximum Speeds per Terrain Type**	
Terrain Type	**S_{MAX}, MPH**
Primary Roads	50
Secondary Roads	40
Trails	20
Cross-Country	30

The off-road speed profile function was modified so the minimum speed would not be less than 1 mph using Equation (3).

$$S_{OFF} = 1.0 + \left[f_{OFF}(D) - f_{OFF}(100) \right] S_{MAX_{OFF}} \tag{3}$$

where
f_{OFF} = normalized speed profile for off-road

The data presented in Table 6 present the MSR for a large number of operationally relevant mission scenarios. The several "standard" mission scenarios (Tactical High, Tactical Standard, and Tactical Support) for the Central European areas as defined by TRADOC are included.

Table 6
Various Mission Profiles and Their Severity Rating

Mission Mix				**Challenge Levels**				**Severity Rating**	**Comment**
PRI	**SEC**	**TRL**	**OFF**	**PRI**	**SEC**	**TRL**	**OFF**		
100	0	0	0	50	0	0	0	2.1	
50	50	0	0	50	50	0	0	2.4	
100	0	0	0	100	0	0	0	2.7	
50	50	0	0	100	100	0	0	3.7	
40	40	20	0	100	100	50	0	4.3	
25	25	50	0	100	100	50	0	5.0	
30	**55**	**10**	**5**	**100**	**100**	**80**	**50**	**5.5**	**Tactical Support**
30	30	20	20	100	100	50	25	5.7	
0	0	100	0	100	100	50	0	6.4	
30	30	20	20	100	100	100	25	7.2	
15	15	30	40	100	100	50	25	7.4	
30	30	20	20	100	100	50	50	8.4	
0	0	50	50	0	0	50	25	8.6	
25	25	50	0	100	100	100	0	8.8	
15	15	30	40	100	100	100	25	9.6	

(Continued)

Table 6 (Concluded)									
Mission Mix				Challenge Levels				Severity Rating	Comment
PRI	SEC	TRL	OFF	PRI	SEC	TRL	OFF		
30	30	20	20	100	100	100	50	9.8	
0	0	0	100	0	0	0	25	10.9	
0	0	50	50	0	0	100	25	12.4	
15	15	30	40	100	100	50	50	12.7	
0	0	100	0	100	100	100	0	13.8	
20	**50**	**15**	**15**	**100**	**100**	**100**	**80**	**14.4**	**Tactical Standard**
15	15	30	40	100	100	100	50	15.0	
0	0	50	50	0	0	50	50	15.3	
0	0	50	50	0	0	100	50	19.0	
30	30	20	20	100	100	50	90	20.0	
30	30	20	20	100	100	100	90	21.5	
0	0	0	100	0	0	0	50	24.2	
15	15	30	40	100	100	50	90	36.1	
15	15	30	40	100	100	100	90	38.3	
10	**30**	**10**	**50**	**100**	**100**	**100**	**90**	**44.4**	**Tactical High**
0	0	50	50	0	0	50	90	44.5	
0	0	0	100	0	0	0	70	46.1	
0	0	50	50	0	0	100	90	48.2	
0	0	0	100	0	0	0	80	62.9	
0	0	25	75	0	0	50	90	63.5	
0	0	0	100	0	0	0	90	82.6	
0	0	0	100	0	0	0	100	100.0	

The data presented in Table 7 are an example of several quite different mission scenarios that result in similar MSRs (i.e., approximately 40.6).

Table 7 Various Mission Scenarios Resulting in Similar Ratings								
Mission Mix				Challenge Levels				Severity Rating
PRI	SEC	TRL	OFF	PRI	SEC	TRL	OFF	
0	0	0	100	0	0	0	66	40.5
0	0	20	80	0	0	80	72	41.0
0	0	40	60	0	0	100	78	41.1
0	0	40	60	0	0	50	80	40.3
0	20	20	60	0	100	100	79	40.3
0	20	30	50	0	50	50	87	40.8
0	35	30	35	0	100	100	100	40.8
0	20	35	45	0	80	80	90	40.7
20	20	20	40	100	100	90	95	40.3

Example Studies

A recent NRMM model study was performed comparing the mobility performance of a wheeled vehicle and a tracked vehicle of similar size and weight. As expected, the wheeled vehicle performed better on the less severe terrain by providing faster speeds than the tracked vehicle. The tracked vehicle performed better on the more severe terrain. However, there was not a direct correlation between the relative severity of the mission and the severity of the terrain challenged.

Figure 13 presents the results of many mission scenarios and shows the "crossover" point of the MSR for the wheeled vehicle and the tracked vehicle. The curve "crossover" point represents the MSR point beyond which it would be more beneficial to use a tracked vehicle. This point also presents a somewhat historical design limit for wheeled vehicles. It is very close to the tactical standard MSR and indicates that our design practices yielded the type of vehicle that historical mission scenarios wanted. Tactical standard is defined as "the level of mobility requiring occasional cross-country movement." If more cross-country movement is necessary, then tracked vehicles were designed to accomplish this higher cross-country mission. The results shown in Figure 13 substantiate that the MSR is a viable and verified method for rating vehicle missions.

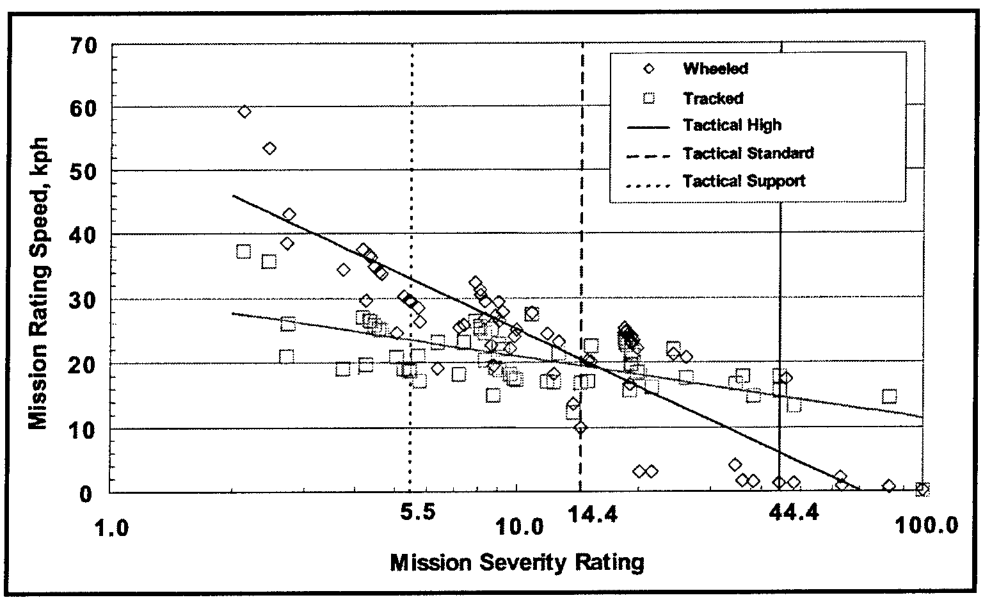

Figure 13. Mission Severity Rating of a wheeled and a tracked vehicle

5 Data Analysis

Introduction

The U.S. military has been developing mission profiles based on "Cold War" fighting tactics and concepts since the 1950s. The current expected vehicle mission levels are generally based on pre-1980 vehicle technologies. The mission level descriptions are suitable for describing vehicle maneuvers, and the method of describing the operational mix is adequate for defining the different percentages of terrains the vehicle is expected to encounter. The relationship of these to actual vehicle missions and to the level of operational difficulty in a quantifiable relationship is what has been lacking. It is evident that each mission level description requires some standard method to quantify the level of difficulty it represents in a valid operational evaluation. The most critical decision that is made during any vehicle development program is defining the expected mission profile that the vehicle must meet. This will be the basis of the vehicle's Operational Requirement Document (ORD). The rationale for development of the vehicle and its expected performance is determined for the ORD based on the mission profile. If this mission profile is not properly defined, then the rationale, performance, and vehicle cost will not be proportionate to the final vehicle design. The current TRADOC accepted mission levels, presented in Table 8, are qualitative descriptions of classical mobility levels over descriptive terrain types.

Table 8
Mission Level Descriptions

Tactical Mission Level	Standard Mission Profile Description
On-Road	All on superhighways, primary and secondary roads, and the best tertiary roads and trails
Tactical Support	Level of mobility requiring infrequent off-road operations over selected terrain with the preponderance of movement on primary and secondary roads
Tactical Standard	Level of mobility requiring occasional cross-country movement
Tactical High	Level of mobility requiring extensive cross-country operations in the ground-gaining and fire-support environment
High-High	All off-road operation

The mission levels are also defined in terms of the percent of expected mission distance spent in each terrain type and are presented in Table 9. These percentages differ depending on the expected region of deployment. One shortfall to this limited descriptive method is comparison of the different mission levels of one region to another and from one mission level to another as shown in Table 9.

Table 9
Percent Operation Mix for Tactical Mission Levels

	Operation Mix			
	Roads			
Mission	**%primary**	**%secondary**	**% trails**	**% cross-country**
Central Europe Scenario Areas				
On-road	35	60	5	0
Tactical Support	30	55	10	5
Tactical Standard	20	50	15	15
USMC	30	30	20	20
Tactical High	10	30	10	50
High-High	0	0	0	100
Mid-East Scenario Areas				
On-road	30	40	30	0
Tactical Support	20	40	35	5
Tactical Standard	15	35	35	15
Tactical High	5	20	25	50
High-High	0	0	0	100

It is difficult to determine the mission for which the system should be designed and the relative level of difficulty between the different missions. The assumption in this process is that the higher percentage of cross-country terrain, the more difficult the mission level, and inversely, the higher percentage of primary roads, the more benign the mission. The technique used for the USMC HIMARS data analysis quantifies the mission level and compares these results against the vehicle's ability to traffic the different terrain types. This method ties the HIMARS mission profile, in different world regions, to a quantifiable tactical mission level.

Toolkit Results

The results of the Toolkit evaluations were used to analyze routing results to show performance differences in the selected corridors, contrast routing results with existing mission levels, and recommend mission profiles for USMC HIMARS deployment scenarios. The Mission Rating Speed was used as a vehicle performance indicator, the Mission Severity Rating was used as a mission level indicator, and the terrain types encountered during mission operations were used to create the mission profiles. The MRS and MSR used a 100-percent value as the terrain challenge level and the average speed over 100 percent of each terrain type encountered. This process is shown in the data presented in Table 6.

The results presented in the following figures require a detailed explanation of the relationships presented in the charts along with a series of explanations that relate each chart to a specific mission and correlate each chart to the others. The following series of charts explain the mission analysis for the MTVR operating in the Germany terrain for each mission scenario (CSA to ATP, ATP to AHA, AHA to FP, CSA to FP), in both a dry normal and wet normal weather scenario, with and without a trailer. The composite velocity, defined by MRS and as explained in Chapter 2, is the fastest possible velocity the vehicle could safely achieve at maximum engine RPM. The charts represent a performance relationship between the vehicle's composite velocity as defined by the MRS, and the percentage of terrain types encountered during its mission, defined by the Mission Severity Index (MSI) which is plotted on a Log axis. The MSI is the index used to define the Mission Severity Profile (MSP.) The charts indicate the level of severity for each standard mission, presented in Tables 8 and 9, and show these standard mission levels as reference lines for comparison to the selected vehicle mission. The average MRS and MSI are shown for each vehicle and vehicle configuration to indicate the general level of mission difficulty and vehicle performance.

The data presented in Figure 14 show the MRS performance differences between the MTVR and MTVR towing a M1095 trailer. Each data point represents a mission segment for all selected corridors between the CSA and ATP as shown in Figure 5 and for two weather conditions, dry normal and wet normal. The data trend represents the concept that the more severe the mission, the slower the vehicle's mission speed. This performance difference in the MRS velocities between the two vehicle configurations is attributed to the extra resistance of the trailer. The performance difference between the two vehicle configurations in the vehicle's MSI performance is attributed to the ability of the MTVR without a trailer to select more difficult terrains at faster velocities than the MTVR towing a trailer. The MTVR without a trailer could have selected the same routes as the MTVR towing a trailer, but the vehicle would have had to travel longer paths to reach the same destination. The RAR is designed to select the fastest possible and straightest available paths regardless of terrain type. The average MSI for this mission scenario for both vehicles is closest to the tactical support mission level.

The data presented in Figure 15 show the results for the ATP to AHA mission. The same trends shown in Figure 14 are also present in Figure 15. The MRS performance differences are similar for this mission, but the MSI performance difference between the two missions, CSA to ATP and ATP to AHA, shows an increase in mission severity. This could be due to the number of total missions, which increased in the ATP to AHA mission, available roads, or an increase in more severe terrains. The MSI is based on the concept that the fewer roads traveled, the higher the MSI becomes for similar missions.

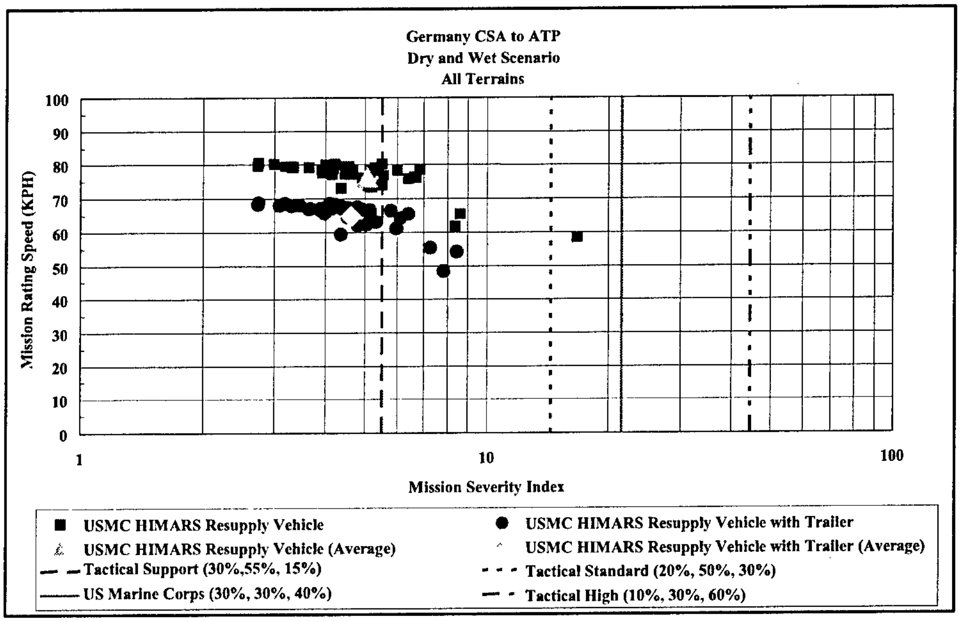

Figure 14. CSA to ATP Mission for MTVR operating in Germany.

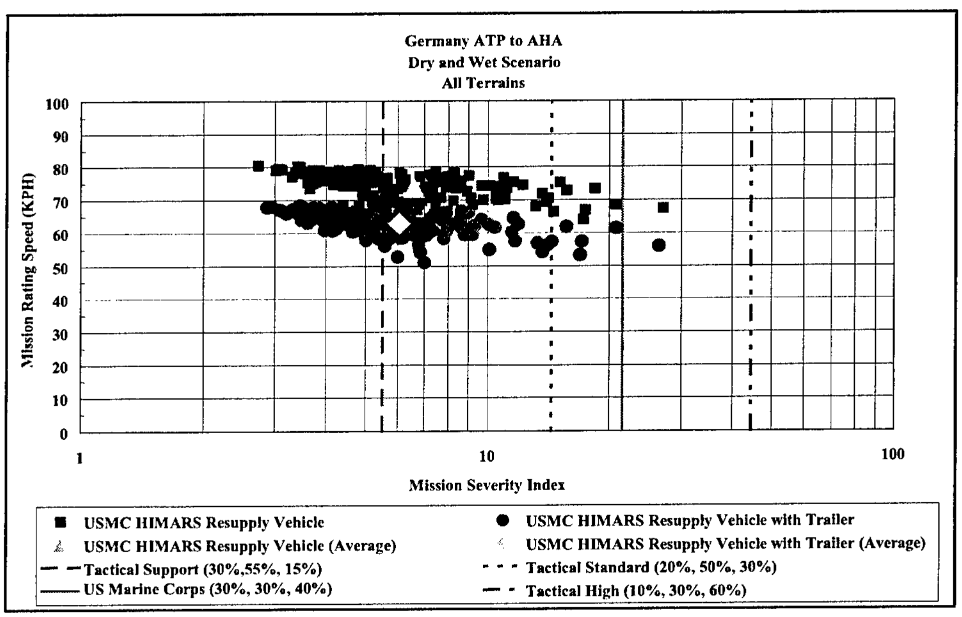

Figure 15. ATP to AHA mission for the MTVR operating in Germany

The average MSI for both vehicle configurations indicates a rise in the mission level from below a tactical support to above a tactical support.

The data presented in Figure 16 show the results for the AHA to FP mission. The range of vehicle performance for both the MRS and MSI is much larger for this mission than the previous two. This is in part due to the change in the mission scenario. The AHA to FP mission is designed for the vehicle to travel a 3- to 6-km mission, locate a firing position, launch the HIMARS, and leave the launch area. This causes the vehicle to search a limited area for roads and forces the vehicle to use trails and travel cross-country more often. As shown in Figure 16, the average MSI is very close to the standard Marine Corps mission level.

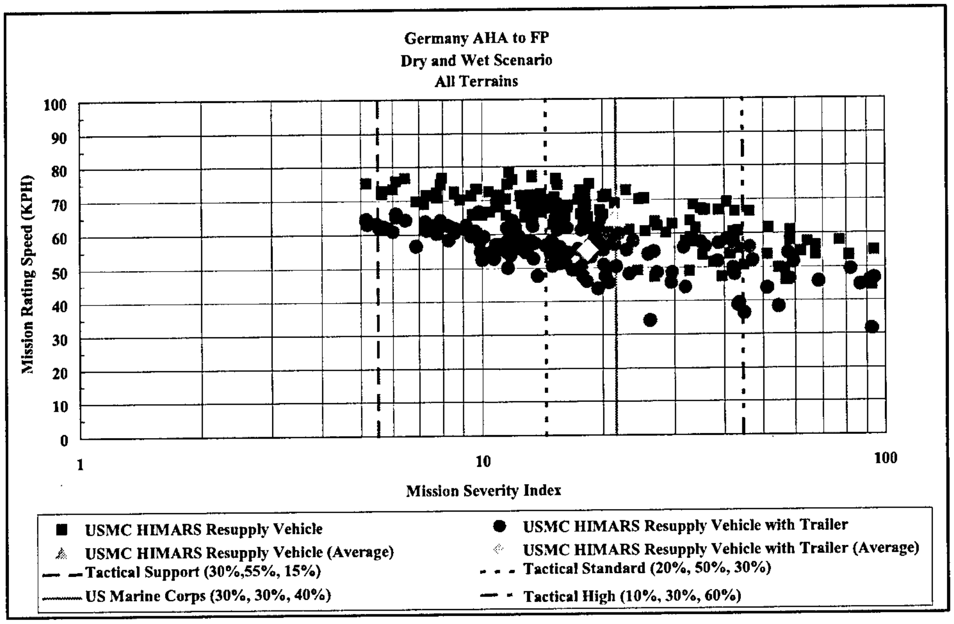

Figure 16. AHA to FP mission for the MTVR operating in Germany

The data presented in Figure 17 show the performance results for the MTVR for all missions conducted in Germany. The total number of missions is significant as well as the range of performance. The number of missions is important for the statistical analysis and for developing a confidence in the performance trend. The average MSI for the MTVR operating in a German terrain is between the tactical support and tactical standard mission levels. The range of performance necessary to complete this mission is significant in the range of MSIs. This means the vehicle should be capable of negotiating cross-country terrain on an occasional to infrequent basis.

The data presented in Figure 18 show each terrain type encountered as a percentage of the total mission. The four terrains, primary and secondary roads, trails and cross-country, are shown as a percentage of the total mission for both weather scenarios and vehicle configurations. These percentages are summed and averaged for the mission results from the CSA to the FP. This creates the average MSI performance shown in Figure 17.

Similar performance charts for the MK48-14 with and without towed M1095 trailer and for the other selected deployment regions for all vehicle configurations are presented in Appendix C.

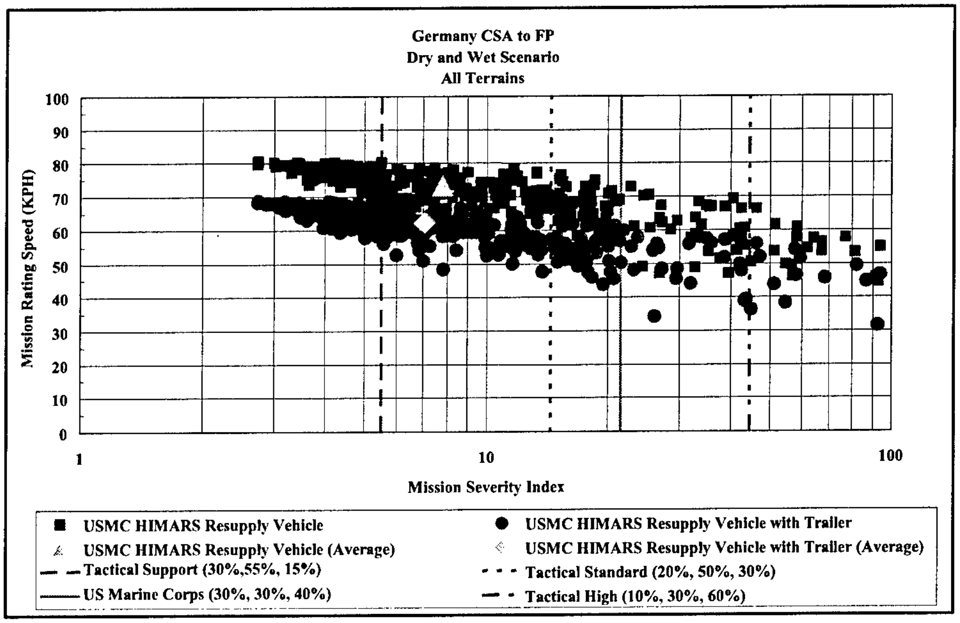

Figure 17. Combined missions from CSA to FP for the MTVR operating in Germany

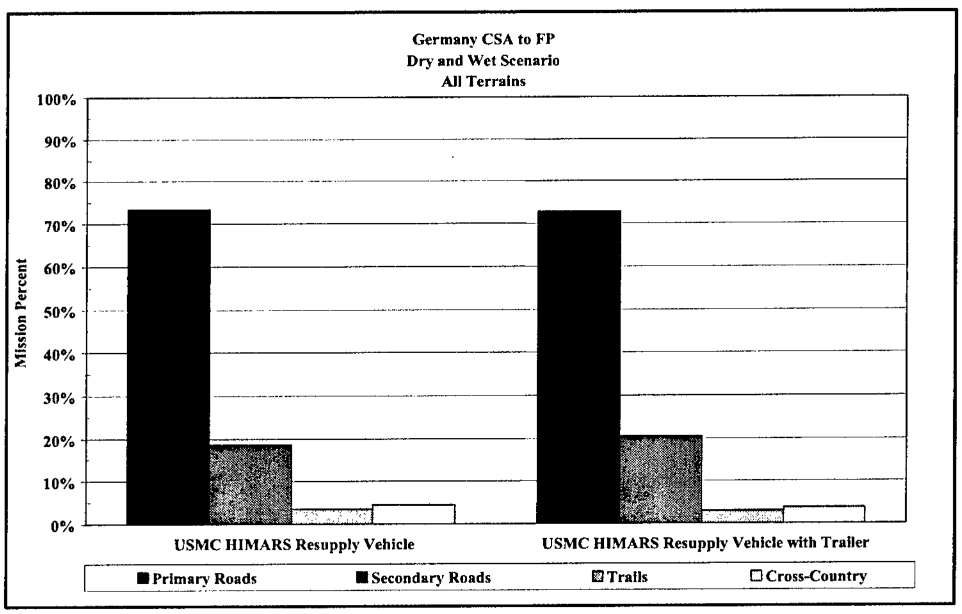

Figure 18. Combined terrains encountered for missions from the CSA to FP for the MTVR operating in Germany

The following tabular data presented in Figures 19 through 22 show the model results for the MTVR and LVS, with and without towing the M1095 trailer, for operations in the study regions for both the dry and wet normal weather scenarios. The tabular data also contain the standard mission profile levels with the associated terrain percentages and mission severity rating using the MSI values. The average route distance and total route distance are presented in the tables. The average route distance is the average length of the multiple

Germany									
		Average Route Distance	Total Route Distance	Terrain Types				Dry and Wet Scenarios	
Vehicle	Dry and Wet Scenario	km	km	%Primary	%Secondary	%Trail	%X-Country	MRS, kph	MSR
USMC HIMARS Resupply Vehicle	CSA to ATP	34	723	87	9	3	2	77	5
	ATP to AHA	32	2584	73	20	3	3	74	7
	AHA to FP	5	373	49	27	7	18	65	21
	CSA to FP	22	3681	73	19	4	4	73	8
USMC HIMARS Resupply Vehicle with Traile	CSA to ATP	35	729	86	11	2	2	65	5
	ATP to AHA	32	2631	73	22	3	3	63	6
	AHA to FP	6	390	51	29	5	15	55	18
	CSA to FP	22	3749	73	20	3	4	62	7
MK48 LVS	CSA to ATP	35	745	94	4	1	1	66	4
	ATP to AHA	33	2740	87	11	1	2	61	5
	AHA to FP	6	427	69	20	1	9	52	12
	CSA to FP	23	3912	86	10	1	2	61	5
MK48 LVS with Trailer	CSA to ATP	35	741	93	4	1	1	54	4
	ATP to AHA	33	2690	82	14	1	2	50	5
	AHA to FP	6	419	67	22	2	10	43	13
	CSA to FP	23	3850	83	13	1	3	50	6
Combined Vehicle Averages				77	16	2	5	61	8
Standard Mission Profile									
Tactical Support				30	55	10	5		6
Tactical Standard				20	50	15	15		14
U.S. Marine Corps				30	30	20	20		22
Tactical High				10	30	10	50		44

Figure 19. Model results for HIMARS operations in Germany with combined dry and wet scenarios

Korea									
		Average Route Distance	Total Route Distance	Terrain Types				Dry and Wet Scenarios	
Vehicle	Dry and Wet Scenario	km	km	%Primary	%Secondary	%Trail	%X-Country	MRS,kph	MSR
USMC HIMARS Resupply Vehicle	CSA to ATP	30	833	66	23	6	6	67	10
	ATP to AHA	37	1245	53	36	7	4	67	9
	AHA to FP	7	442	49	26	10	14	60	18
	CSA to FP	20	2520	57	30	7	7	66	11
USMC HIMARS Resupply Vehicle with Trailer	CSA to ATP	30	849	66	23	7	5	55	9
	ATP to AHA	37	1272	55	36	6	3	55	7
	AHA to FP	7	452	51	27	10	12	48	16
	CSA to FP	21	2573	58	30	7	5	54	9
MK48 LVS	CSA to ATP	30	836	68	23	4	4	49	8
	ATP to AHA	38	1277	57	36	5	2	48	6
	AHA to FP	7	468	58	26	6	10	42	13
	CSA to FP	21	2581	61	30	5	4	47	8
MK48 LVS with Trailer	CSA to ATP	30	852	67	23	6	4	41	8
	ATP to AHA	38	1284	57	36	6	1	42	5
	AHA to FP	7	468	58	25	7	9	36	13
	CSA to FP	21	2604	60	30	6	4	40	8
Combined Vehicle Averages				59	29	7	6	51	10
Standard Mission Profile									
Tactical Support				30	55	10	5		6
Tactical Standard				20	50	15	15		14
U.S. Marine Corps				30	30	20	20		22
Tactical High				10	30	10	50		44

Figure 20. Model results for HIMARS operations in Korea with combined dry and wet scenarios

Iraq									
		Average Route Distance	Total Route Distance	Terrain Types				Dry and Wet Scenarios	
Vehicle	Dry and Wet Scenario	km	km	%Primary	%Secondary	%Trail	%X-Country	MRS , kph	MSR
USMC HIMARS Resupply Vehicle	CSA to ATP	22	417	90	6	0	4	77	7
	ATP to AHA	18	886	67	9	9	14	59	17
	AHA to FP	6	437	18	17	15	50	31	53
	CSA to FP	12	1741	60	11	8	20	50	24
USMC HIMARS Resupply Vehicle with Trailer	CSA to ATP	22	418	90	6	0	4	65	6
	ATP to AHA	19	890	67	10	9	14	49	18
	AHA to FP	6	445	18	18	16	49	26	52
	CSA to FP	12	1753	60	11	9	20	42	24
MK48 LVS	CSA to ATP	22	423	94	3	0	3	64	6
	ATP to AHA	19	899	68	10	11	11	39	15
	AHA to FP	6	464	23	20	16	41	20	45
	CSA to FP	12	1786	62	11	10	17	34	21
MK48 LVS with Trailer	CSA to ATP	22	421	93	3	0	3	52	6
	ATP to AHA	19	898	68	10	10	12	34	16
	AHA to FP	6	464	22	19	18	41	19	45
	CSA to FP	12	1783	62	11	10	18	30	21
Combined Vehicle Averages				60	11	9	20	43	23
Standard Mission Profile									
Tactical Support				30	55	10	5		6
Tactical Standard				20	50	15	15		14
U.S. Marine Corps				30	30	20	20		22
Tactical High				10	30	10	50		44

Figure 21. Model results for HIMARS operations in Iraq with combined dry and wet scenarios

Germany, Korea and Iraq Combined

Vehicle	Dry and Wet Scenario	Average Route Distance km	Total Route Distance km	Terrain Types %Primary	%Secondary	%Trail	%X-Country	Dry and Wet Scenarios MRS, kph	MSR
USMC HIMARS Resupply Vehicle	CSA to ATP	29	1973	78	14	3	4	72	7
	ATP to AHA	29	4715	67	22	5	6	69	9
	AHA to FP	6	1253	38	23	11	28	46	31
	CSA to FP	19	7800	66	20	5	9	65	12
USMC HIMARS Resupply Vehicle with Trailer	CSA to ATP	29	1995	78	15	4	3	60	7
	ATP to AHA	29	4793	67	23	5	5	58	8
	AHA to FP	6	1287	40	24	11	25	38	29
	CSA to FP	19	7931	66	21	5	8	54	11
MK48 LVS	CSA to ATP	29	2005	83	12	2	3	57	6
	ATP to AHA	30	4916	75	17	4	3	52	7
	AHA to FP	7	1358	50	22	8	20	32	24
	CSA to FP	19	8130	74	17	4	6	48	9
MK48 LVS with Trailer	CSA to ATP	30	2014	82	12	3	3	47	6
	ATP to AHA	30	4872	73	19	4	4	44	7
	AHA to FP	6	1351	48	22	9	20	28	24
	CSA to FP	19	8090	72	18	4	6	41	10
Combined Vehicle Averages				66	19	5	10	51	13
Standard Mission Profile									
Tactical Support				30	55	10	5		6
Tactical Standard				20	50	15	15		14
U.S. Marine Corps				30	30	20	20		22
Tactical High				10	30	10	50		44

Figure 22. Combined model results for HIMARS operations in Germany, Korea, and Iraq with combined dry and wet scenarios

corridor segments that were used to make one route. The total route distance is the summation of all routes traveled for two different weather scenarios. The percentages of the different terrain types shown in the tables indicate the percent of the total route distance that the vehicle traveled on each terrain type. The composite vehicle speeds for the mission are presented using the MRS, and the MSR is presented using the MSI values.

The results of the study reveal that the MTVR without or with a towed trailer is operating over more difficult mission profiles than the LVS. This is because of the higher mobility performance of the MTVR and the RAR's selecting the fastest paths over the straightest lines for each mission. If the MTVR is capable of high speeds over severe terrains, and by operating over these severe terrains creates a shorter path to complete the mission than operating over the less severe terrains, then the RAR will select the route with the shortest time to complete the mission. Another scenario that occurs in this type of mission is the vehicle is forced to operate over more severe terrains to avoid nontrafficable NOGO areas. This would cause a higher MSR performance. The difference in operational paths between the two vehicles can be seen in the relative differences between the percentages of terrain types selected and the MSI values for the MTVR and LVS. These results are revealing vehicle performance facts that were already known. The MTVR was designed to outperform the LVS in all conditions. The actual mission level of operational performance that the MTVR would have over the LVS, or which vehicle is more suited to perform each mission, was not known. This analysis shows the differences and contrasts them to standard mission levels. The results also show that the level of mission difficulty is dependent on the part of the world to which the vehicle is deployed. The performance trends presented in the tabular data show that the regions of the world with poor infrastructure produce higher MSRs and lower MRSs.

The results of the study indicate that both vehicles were operating near tactical support mission levels for the German region, except for the AHA to FP mission where it was advantageous for the MTVR to operate at or near the USMC mission level. The LVS was able to operate just below the tactical standard level for the AHA to FP missions. The MSR for the MTVR and LVS configurations operating in Germany is an average 8 MSR and is classified as a tactical support mission level with a terrain type mix of 77 percent primary roads, 16 percent secondary roads, 2 percent trails, and 5 percent cross-country. The Korean mission results show an increase in MSR when compared to the German missions. The average MSR for the vehicles operating in Korea is a 10 MSR and is classified between a tactical support and tactical standard mission level with a terrain type mix of 59 percent primary roads, 29 percent secondary roads, 7 percent trails, and 6 percent cross-country. Iraq produced the most severe average mission results for both vehicles with a 23 MSR and is classified as a USMC mission level with a terrain type mix of 60 percent primary roads, 11 percent secondary roads, 9 percent trails, and 20 percent cross-country. The previous results were combined to produce a worldwide combined assessment for both vehicles. The average MSR for the vehicles operating in Germany, Korea, and Iraq is a 13 MSR and is classified as a tactical standard mission level with a terrain type mix of 66 percent primary roads, 19 percent secondary roads, 5 percent trails, and 10 percent cross-country.

The difference between the tactical standard MSR terrain type mix calculated for the worldwide assessment and the standard mission profile tactical standard terrain type mix is the percent of terrain challenged for the mission. The standard mission challenge level is not required to accomplish 100 percent of the trails and cross-country (as presented in Table 6), as were the vehicles in this study. Because of this higher challenge level, the terrain types mix is significantly different between the two missions but resulted in similar MSR. This makes a noticeable difference in total miles on severe terrains when conducting durability tests for these vehicles. The standard mission profile for tactical standard is 20 percent primary roads, 50 percent secondary roads, 15 percent trails, and 15 percent cross-country. The calculated mission profile shows an increase of 46 percent more miles on primary roads, a decrease of 31 percent fewer miles on secondary roads, a decrease of 10 percent fewer miles on trails, and a decrease of 5 percent fewer miles on cross-country terrains. This is a significant reduction in durability miles over severe terrains and would indicate that vehicles with similar mobility levels, as the LVS, are quite capable of conducting HIMARS missions in a variety of climatic regions. It also reveals that the AHA to FP missions are quite severe, and vehicles with mobility levels similar to the MTVR would be better suited to conduct these missions.

6 Conclusions and Recommendations

Discussion

The TeleEngineering Toolkit, the NATO Reference Mobility Model, the Route Analysis Routine, and the Mission Severity Rating system were used to contrast the different HIMARS missions, over three unique climatic regions of the world, in quantifiable numbers that show the severity of each mission. The applied modeling methods also yielded the mission levels of each unique operational scenario along with the percentage of terrain mix the vehicles encounter during mission operations. The application of these modeling methods to ORD development, vehicle design specifications, and vehicle performance evaluations would give program managers insights as to how component level vehicle modifications would impact the point-to-point operations of the platform as well as vehicle-to-vehicle comparisons.

Recommendations

Based on the objectives of this program and the results of the HIMARS mission analysis presented in this report, the following recommendations are proposed:

- Mission terrain mix for the three study regions be combined to represent typical expected terrain types in the USMC HIMARS vehicle mission profile.
- MTVR be the primary vehicle system for HIMARS when operating missions from the AHAs to the FPs in world regions with limited infrastructure.
- Future durability testing of the HIMARS transport vehicles and HIMARS payloads follow the calculated mission levels in this report.

Additional modeling analysis, similar to the methods presented here, should be conducted on all USMC vehicles. Application of this analysis to USMC vehicles would baseline the expected mission levels of the various USMC mission scenarios. It would also allow the evaluation of possible vehicle enhancements and develop future durability testing requirements for current USMC vehicles.

References

Ahlvin, R. B., and Haley, P. W. (1992). "NATO reference mobility model, edition II, NRMM II user's guide," Technical Report GL-92-19 (AD B170301), U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Haley P. W., Jurkat, M. P., and Brady, P. M., Jr. (1979). "NATO reference mobility model, Edition I, Users guide, Volume I, Operational modules," Technical Report 12503 (AD B047979L), U.S. Army Tank-Automotive Research & Development Command, Warren, MI.

McKinley, G. B., Webb, B. T., and Horner, D. A. (2002). "Methodology for mobility tactical decision aids incorporated in the joint mapping tool kit," Technical Report ERDC/GSL TR-02-07, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Schreiner, B. G., and Willoughby, W. E. (1976). "Validation of the AMC-71 mobility model," Technical Report M-76-5, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

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Appendix A
Vehicle Characterization

U.S. Marine Corps (USMC) Study Vehicles

The Medium Tactical Vehicle Replacement (MTVR) presented in Figure A1 is built for the USMC. This high performance, all-terrain vehicle can haul 15 tons over the highway and up to 7 tons off-road. It is fully air transportable. This 21st-century-technology vehicle incorporates Oshkosh Truck's TAK-4™ independent suspension, J1939 databus self-diagnostics technology, Central Tire Inflation System (CTIS), Anti-lock Brake System (ABS), and Command Zone™ Plus electronics. MTVR vehicle characteristics are presented in Figure A2.

Figure A1. MTVR, Extra Long Wheel Base

Medium Tactical Vehicle Replacement Extra Long Wheel Base	
Curb Weight:	31,069 lb
Axle Weights:	13,228 lb, 16,131 lb, 16,305 lb
Length:	386.5 in.
Width:	97.4 in.
Height:	141.2 in.
Pushbar Height	36.8 in.
Driver's Eye Height:	105.5 in.
Tire Deflections:	Hwy: 2.23 , 2.26, 2.28 in. CC: 3.29, 3.21, 3.24 in.
Fording Capability:	60 in.

Figure A2. MTVR, Extra Long Wheel Base vehicle characteristics

Other characteristics of the MTVR include the following:

Engine: Caterpillar C12, 425 hp
Transmission: Allison HD 4070P automatic, 7-speed
Axle, Front: Rockwell SVI 5MR, planetary hub reduction, differential lock
Axle, Rear: Rockwell SVI 5MR, planetary hub reduction, differential lock
Transfer Case: Oshkosh model 55000
Maximum Speed (GCW Road): 65 mph (105 km/h)
Cruising Range: 336 miles (540.7 km)
Fording Capability: 60 in. (1524 mm)
Air Transportability: C5A, C17, C130 and C141 (with preparation)

The MK48/14, pictured in Figure A3, is a Logistics Vehicle System (LVS) with a container transporter rear body unit. The MK48 front power unit is a 4×4 diesel-powered vehicle with automatic transmission and two steering axles. The MK14 container transporter rear body unit is a flatbed trailer with two powered axles that can secure 20-ft standard containers, the standard Marine Corps Expeditionary Shelter System, and Marine Corps Field Logistics System bulk liquid tanks and pump units. A hydraulically powered articulated joint joins the front power unit and the rear body unit. This articulated joint helps steer the vehicle and allows more mobility with a degree of independent movement between the front and rear units. The front power unit and the rear body unit together make an 8×8 system. MTVR vehicle characteristics are presented in Figure A4.

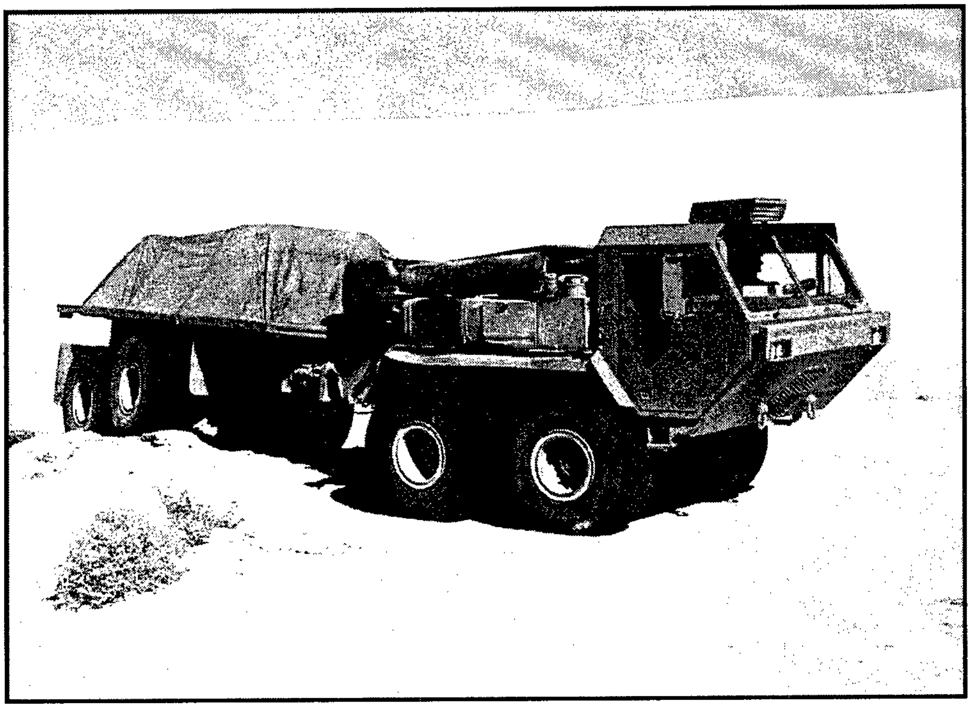

Figure A3. MK48/14 is a Logistics Vehicle System (LVS) with a container transporter rear body unit

MK48/14 LVS	
Curb Weight:	40,300 lb
Axle Weights:	16,550 lb, 14,625 lb, 17,225 lb, 17,600 lb
Length:	456 in.
Width:	96 In.
Height: Pushbar Height: Driver's Eye Height:	102 in. 42 in. 88 in.
Tire Deflections:	Hwy: 2.0 in. CC: 3.2 in.
Fording Capability:	60 in.

Figure A4. MK48/14 Logistics Vehicle System (LVS) vehicle characteristics

Additional vehicle characteristics of the MK48/14 include:

- Engine: Detroit Diesel 8V92TA, 445 bhp (332 kW) @ 2100 RPM
- Transmission: Allison HT-740D, 4-speed automatic
- Axle, Front (No.1): Oshkosh 23K
- Axle, Front (No.2): Eaton RS-381
- Axle, Rear: Eaton DS-580
- Transfer Case: Oshkosh 2-speed
- Maximum Speed (GCW Road): 52 mph (84 km/h)
- Cruising Range: 300 miles (483 km)

Rear Modules: wrecker/recovery vehicle, truck tractor, cargo truck with materiel handling crane, and International Standards Organization (ISO) container hauler logistics platform

TeleEngineering Toolkit and NRMM Vehicle Files

MK48-14 Vehicle File

```
 MK48/14, LVS (16.00R21GY-45PSI) 2FEB88 (Modified 2MAR97, added Engine data)
 Project:R.Jones, 17Apr02, USMC-HIMARS
 Changed the TF on 12May97,: Mr.S.FOX E-MAIL new numbers to be used for the
                            :TF, LVS TRACTIVE EFFORT
 Modified:Added Engine and Hi&Lo Trans. data
         :Used Engine Data instead of TF I/P it made a small change in the
         :results.
 Project: Marine Corps, NSWC Stochastic NRMM project
! File Name:c:vehicles\nrmmii\mk48.dat
 File Name:c:\jones02\usmc-himars\vehicles\mk48-14.dat
 MK48/14, LVS (16.00R21 GY-45PSI) 2FEB88 (Modified 2MAR97, added Engine data)
 $VEHICLE
   NAMBLY= 4,
   WGHT(1)=16550,14625,17225,17600,
 NVUNTS=1,
 VULEN(1)= 456,     !Jane's95-96 pg519, LVS(Logistic Vehicle System)Form MK 11-85
 CGH   =61.2,
 CGLAT = 0,
 CGR   =152.3,
 CL    =13,
 CLRMIN(1)=13,13,13,13,
 EYEHGT=88,
 PBF   =66000,
 PBHT  =42,
 PFA   =53,        !changed from 39 to 53
! VAA   =45,       !Jane's95-96 pg519, LVS(Logistic Vehicle System)Form MK 11-85
! VDA   =45,       !Jane's95-96 pg519, LVS(Logistic Vehicle System)Form MK 11-85
 WDTH  =96,        !Jane's95-96 pg519, LVS(Logistic Vehicle System)Form MK 11-85
   AVGC=990,
   AXLSP(1) =60,199,60,
!   DFLCT(1,1)=2.9,2.9,2.9,2.9,
!   DFLCT(1,2)=,
!   DFLCT(1,3)=,
   DFLCT(1,1)=2.0,2.0,2.0,2.0,  !HWY,  4Apr02, used M977(HEMTT) defl.
   DFLCT(1,2)=3.2,3.2,3.2,3.2,  !cc,   4Apr02, used M977(HEMTT) defl.
   DFLCT(1,3)=4.3,4.3,4.3,4.3,  !sand, 4Apr02, used M977(HEMTT) defl.
   DFLCT(1,4)=4.7,4.7,4.7,4.7,  !emer, 4Apr02, used M977(HEMTT) defl.
   DIAW(1)  =51.2,51.2,51.2,51.2,
!   KCTIOP(1)= 8*1,
   KCTIOP(1)= 8*0,        !23Apr02 NOT A CTI VEH. but for R.Jones project USMC
                          !HIMARS set it for CTI
!   NJPSI=1,
!   JVPSI=1,
   NJPSI=4,                   !4Apr02
   JVPSI=2,                   !4Apr02
   ICONST(1)=0,0,0,0,         !0=Radial
   ID(1)    =0,0,0,0,         !0=Not Duals
   IT(1)    =1,1,2,2,         !Tandem,Tandem changed 23Jan.97 from 1,2,1,2
   KTSFLG   =1,1,1,1,         !Radial
   NCHAIN(1)=0,0,0,0,         !0=None
   NVEH(1)  =1,1,1,1,         !1=Wheeled
   NWHL(1)  =2,2,2,2,         !# of tires per axle
   RDIAM(1) =21,21,21,21,
   RIMW(1)  =10,10,10,10,
   SECTH(1) =15.1,15.1,15.1,15.1,
   SECTW(1) =17.1,17.1,17.1,17.1,
   TL=319,
   TPLY(1)  =26,26,26,26,
!   TPSI(1,1)=45,45,45,45,    !hwy
!   TPSI(1,2)=,
!   TPSI(1,3)=,
   TPSI(1,1)=60,60,70,70,     !hwy,  4Apr02, used M977(HEMTT)TPSI
   TPSI(1,2)=35,35,40,40,     !CC,   4Apr02, used M977(HEMTT)TPSI
   TPSI(1,3)=20,20,30,30,     !SAND, 4Apr02, used M977(HEMTT)TPSI
   TPSI(1,4)=15,15,19,19,     !EMER, 4Apr02, used M977(HEMTT)TPSI
!   VTIRMX(1)=100,100,100,100,
   VTIRMX(1)=60,40,12,5,      !23Apr02
 ! WI=61.9,
   WT(1)    =79,79,79,79,     !LVS(Logistic Vehicle System)MK 11-85 from picture
   WTE(1)   =61.9,61.9,61.9,61.9,
```

```
 CID= 736,                     !LVS(Logistic Vehicle System)Form MK 11-85,
                               !:Detroit Diesel 8V92TA
 ICONV1= ,
 CONV1 =  ,  ,
 ICONV2=  ,
 CONV2 =  ,  ,
! IENGIN=  9,
! ENGINE= 340,   4628,
!         515,   3186,
!         800,   1757,
!         1000,  1673,
!         1180,  1334,
!         1629,  967,
!         1891,  868,
!         2018,  829,
!         2383,  661,
   FD(1) =5.45,0.95,
   HPNET =445,       !Jane's95-96 pg.519,LVS(Logistic Vehicle System)Form MK11-85
 !  IAPG  =  2,
   IB(1) = 1,1,1,1, !1=Braked
   IDIESL=  2,
   IP(1) =1,1,1,1,  !1=Powered
 !  ITCASE=  1,
 !  ITRAN =  1,
   ITVAR =  0,
   KTROPR(1) = 8*0,
   LOCDIF=  1,       !1=Yes, Locking differential
   LOCKUP=  1,
   NCYL  =  8,
   NENG  =  1,
   QMAX  =1250,
!   REVM(1) =418,418,418,418,
   REVM(1) =394,394,394,394,
   TCASE(1)=1.0,1.0,
   TQIND =   ,
!   NGR   =  8,
   NGR   =  4,
   NTRANG = 2,
!   TRANS=9.81,0.95,
!         5.37,0.95,
!         3.69,0.95,
!         3.67,0.95,
!         2.66,0.95,
!         2.02,0.95,
!         1.38,0.95,
!         1.00,0.95,
   TRANS(1,1,1) = 4.28,0.95,
                  2.34,0.95,
                  1.60,0.95,
                  1.16,0.95,
   TRANS(1,1,2) = 7.82,0.95,
                  4.28,0.95,
                  2.92,0.95,
                  2.12,0.95,
!TRACTIVE EFFORT VS SPEED, LVS, 66000 LB, DDA 8V-92, ALLISON HT-740
!REVISED  5/12/97, POWER CURVE FROM E-MAIL, S.FOX
!2.12 DROP BOX RATIO
!                SPEED MPH      TRACTIVE EFFORT LBS
  IPOWER(1)= 30,
  POWER(1,1,1)=0.0,          47936, !*
               1.0,          42162,
               1.46,         39600,
               2.0,          36779,
               3,            30894,
               4,            25943,
               5,            21644,
               6,            19635,
               7,            18014,
               8,            13350,
               9,            12180,
               10,           10202,
               11,           8152,
               12,           10367,
               13,           9815,
               14,           7619,
               15,           6707,
               16,           7499,
               17,           7290,
               18,           7093,
               19,           6797,
               20,           5083,
```

```
                21,            4710,
                22,            4188,
                23,            5321,
                24,            5205,
                25,            5087,
                26,            4943,
                27,            4777,
                27.84,         3113,
!*EXCEEDS  VEHICLE TRACTION LIMIT, POWER CURVE FROM E-MAIL, S.Fox
!1.16  DROP BOX RATIO
!               SPEED MPH      TRACTIVE EFFORT
  IPOWER(2)= 27,
  POWER(1,1,2)=0,               26229,
                2,              22772,
                4,              19524,
                6,              16084,
                8,              13305,
                10,             10119,
                12,             10277,
                14,             7536,
                16,             6816,
                18,             5740,
                20,             4526,
                22,             5663,
                24,             5322,
                26,             4054,
                28,             3501,
                30,             4059,
                32,             3930,
                34,             3783,
                36,             3595,
                38,             2635,
                40,             2325,
                42,             2913,
                44,             2844,
                46,             2771,
                48,             2682,
                50,             2481,
                50.88,          1703,
!   IPOWER= 0,
!   IPOWER= 28,
!   POWER= 0. ,54006,
!          1. ,48770,
!          1.9,43218,
!          2.9,36725,
!          3.8,27820,
!          4.8,24470,
!          5.7,18954,
!          6.7,17442,
!          7.7,15917,
!          8.6,14370,
!          9.5,13334,
!         10.5,12822,
!         12.4,10222,
!         14.4, 9180,
!         16.2, 6986,
!         19.1, 6158,
!         21.9, 5747,
!         23.9, 5275,
!         26.7, 4725,
!         28.6, 3658,
!         33.4, 3442,
!         38.1, 3147,
!         43. , 2510,
!         47.8, 2432,
!         50.6, 2338,
!         52.5, 2233,
!         57.3, 2180,
!         60.2, 2128,
 ACD   =1.0,
 CD    = .7,
 XBRCOF= .8,
   NHVALS=12,
   HVALS=  0,    7, 7.1, 7.2, 7.5,
           8,    9,  10,  12,  14,
          24,   60,
   VOOB = 60,   60,  20,  11, 7.5,
         5.5,    5, 4.5, 3.5, 2.8,
           2,    2,
 !  NSVALS= 0,
   MAXIPR=14,
```

```
   MAXL=    1,
   RMS=            0, .15,  .2, .3,  .4,
                  .5,  .6, .75,  1, 1.5,
                   2,   3,   4,  5,
   VRIDE(1,1,1)= 60,  60,  40, 30, 24.5,
                 21,  18,  15, 13,   11,
                9.5,   8, 6.5,  6,
   VRIDE(1,2,1)=,
   VRIDE(1,3,1)=,
 DRAFT =  ,
 FORDD =  ,
 SAE   =  ,
 SAI   =  ,
 VFS   =  ,
 VSS   =  ,
 VSSAXP=  ,
 WC    =  ,
 NWR   =  ,
 WDAXP =  ,
 WDPTH(1)=  ,
 WRAT(1) =  ,
 WRFORD=  ,
 $END
NOHGT        !1  MK48/14, 14May97
     3       !c:\vehicles\nrmmii\obsmod\mk48-14.obv
NANG         !c:\vehicles\nrmmii\obsmod\mk48-14.obo
     8       !c:\vehicles\nrmmii\obsmod\obw.dat !standard set
NWDTH        !c:\tacom-ob\obsdp < obsdp.inp
     3
```

CLRMIN INCHES	FOOMAX POUNDS	FOO POUNDS	HOVALS INCHES	AVALS RADIANS	WVALS INCHES
9.94	9323.3	354.4	3.15	1.95	5.88
-2.85	28257.6	1822.6	15.75	1.95	5.88
-11.39	54317.2	3949.5	33.46	1.95	5.88
9.94	9323.3	360.2	3.15	2.48	5.88
-1.16	22798.8	1668.0	15.75	2.48	5.88
-4.82	28207.3	2829.6	33.46	2.48	5.88
9.85	8427.8	287.0	3.15	2.69	5.88
2.46	18767.6	1274.5	15.75	2.69	5.88
-4.33	19466.4	2314.1	33.46	2.69	5.88
9.97	5022.3	309.2	3.15	2.86	5.88
5.76	11280.0	896.5	15.75	2.86	5.88
-0.67	11809.2	1545.3	33.46	2.86	5.88
11.58	5049.6	239.1	3.15	3.42	5.88
7.53	7705.4	472.7	15.75	3.42	5.88
7.53	11658.1	1445.5	33.46	3.42	5.88
12.14	6576.7	233.8	3.15	3.60	5.88
6.15	8316.4	585.8	15.75	3.60	5.88
5.52	19429.8	1185.1	33.46	3.60	5.88
12.51	4632.5	72.8	3.15	3.80	5.88
7.61	12594.6	730.1	15.75	3.80	5.88
6.33	12490.6	641.2	33.46	3.80	5.88
12.90	2826.4	12.9	3.15	4.33	5.88
12.40	5377.5	150.7	15.75	4.33	5.88
10.88	11412.8	746.7	33.46	4.33	5.88
9.75	8343.1	242.4	3.15	1.95	29.88
6.20	19763.8	610.8	15.75	1.95	29.88
-9.09	53693.3	1992.9	33.46	1.95	29.88
9.75	8343.1	246.5	3.15	2.48	29.88
6.86	18882.3	956.6	15.75	2.48	29.88
-4.80	28046.1	1637.4	33.46	2.48	29.88
9.85	8427.8	268.5	3.15	2.69	29.88
7.02	15557.3	750.7	15.75	2.69	29.88
-4.25	18704.9	1970.6	33.46	2.69	29.88
9.94	5018.4	220.0	3.15	2.86	29.88
6.85	11269.5	759.9	15.75	2.86	29.88
0.82	11806.7	1404.6	33.46	2.86	29.88
11.57	5050.3	296.3	3.15	3.42	29.88
7.62	11226.2	715.4	15.75	3.42	29.88
7.47	11656.7	1613.5	33.46	3.42	29.88
11.45	8542.5	302.7	3.15	3.60	29.88
6.75	11379.4	580.5	15.75	3.60	29.88
5.32	19646.5	1628.9	33.46	3.60	29.88
11.50	8269.0	237.1	3.15	3.80	29.88
6.48	12649.7	690.5	15.75	3.80	29.88
5.58	28922.9	1042.0	33.46	3.80	29.88
10.19	12788.4	1033.0	3.15	4.33	29.88
10.31	15484.3	763.2	15.75	4.33	29.88
6.23	21760.3	699.6	33.46	4.33	29.88
10.93	8343.7	188.9	3.15	1.95	141.60
5.56	18958.1	1087.8	15.75	1.95	141.60

```
  -8.23   47587.9    1186.5     33.46      1.95    141.60
  10.93    8343.7     191.3      3.15      2.48    141.60
   6.59   19115.6     900.2     15.75      2.48    141.60
   0.83   18624.1    1063.8     33.46      2.48    141.60
  11.09    8428.4     213.5      3.15      2.69    141.60
   6.82   18777.7     776.5     15.75      2.69    141.60
   5.20   12464.7    1108.4     33.46      2.69    141.60
  11.00    5000.9     180.1      3.15      2.86    141.60
   6.93    7659.7     583.1     15.75      2.86    141.60
   7.91    9255.7     927.6     33.46      2.86    141.60
  11.11    5029.7     214.6      3.15      3.42    141.60
   7.61   11127.4     933.3     15.75      3.42    141.60
   7.41   11654.0    1094.5     33.46      3.42    141.60
  11.17    8461.4     214.1      3.15      3.60    141.60
   5.64   12518.6    1000.9     15.75      3.60    141.60
   3.35   19621.3    1563.9     33.46      3.60    141.60
  10.96    7806.6     183.0      3.15      3.80    141.60
   5.36   18427.4    1076.3     15.75      3.80    141.60
  -6.93   29597.3    1857.7     33.46      3.80    141.60
  11.08    7828.3     131.0      3.15      4.33    141.60
   5.47   14842.8     654.2     15.75      4.33    141.60
  -7.71   35106.9    1971.5     33.46      4.33    141.60
 MK48/14, 14May97
 $VEHICL
! RB.Ahlvin WES/MSD 24Nov93
! Comments: can't use comments before the $VEHICL line.
!         : use only after the $VEHICL line
   NUNITS =  1,     ! Number of units
   NSUSP  =  2,     ! Number of suspension supports
   NVEH1  =  1,     ! Vehicle type; 0=tracked, 1=wheeled
   NFL    =  0,     ! Track type; 0=rigid, 1=flexible
   REFHT1 = 41.5,   ! Height of hitch from ground
   HTCHFZ =     0,  ! V-force on hitch
   SFLAG(1) = 1,1,  ! Type susp @supt-i,0=indp,1=bogie
!  Power flags ((IP(i,j), i=1,nsusp) j=1,2)
!  IP(1,1)  =1,1,1,1,
   IP(1,1)  =1,1,0,0,0,  !27April99
   IP(1,2)  =1,1,0,0,0,
!  Brake flags ((IB(i,j), i=1,nsusp) j=1,2)
!  IB(1,1)  = 1,1,1,1,
   IB(1,1)  = 1,1,0,0,0, !27April99
   IB(1,2)  = 1,1,0,0,0,
   EFFRAD(1)=25.6, 25.6,!Effective loaded radius wheels/plus trk thickness wrt ground
   ELL(1)   = 346.8,87.7,         !Horiz. pos. suspension WRT hitch
   BWIDTH(1)=60,60,      !Bogie arm length (centerline wheel to centerline wheel)
   BALMU(1) =  6,12               !Bogie max CCW. angl, (+=CCW.)
   BALMD(1) =-12,-6,              !Bogie max CW. angl, (+=CCW.)
   EQUILF(1)= 31175, 34825,       !Equilibrium force
   CGZ1     =     61.2,       ! V-cg, Unit-1 wrt ground
   CGZ2     =  0              ! V-cg, Unit-2 wrt ground
   DEE1     =  0              ! H-cg, Unit-1 payload wrt hitch
   ZEE1     =  0              ! V-cg, Unit-1 payload wrt ground
   DEE2     =  0              ! H-cg, Unit-2 payload wrt hitch
   ZEE2     =  0              ! V-cg, Unit-2 payload wrt ground
   DELTW1   =  0              ! Payload weight, Unit-1
   DELTW2   =  0              ! Payload weight, Unit-2
   NPTSC1   = 16,             ! #Pts, bottom profile, Unit-1
   XCLC1(1) =  452,    452,    429,  406,  356,    !Unit-1
               347,    292,    271,  213,  149,
             101.0,  90.0,   30.0,    10,    0,
              -9.2,
   YCLC1(1) = 69.7,     60,     36,   36, 16.6,    !Unit-1
              16.6,     21,     31, 29.5,   28,
              12.9,   12.9,     35,   35, 41.5,
                 61,
   NPTSC2   =,!#Pts, bottom prof.
   XCLC2(1) =,
   YCLC2(1) =,
   SFLAG(4) = 0,            ! Type suspension front "spridler" (always zero)
   IP(4,1)  =,              ! Power flag, front "spridler"
   IB(4,1)  =,              ! Brake flag, front "spridler"
   ELL(4)   =,              ! H-pos front "spridler" wrt hitch
   ZS(4)    =,              ! V-pos centerline front "spridler" wrt ground
   EFFRAD(4)=,              ! Effective radius front "spridler" measure from
                            ! centerline to outher edge of track
   SFLAG(5) = 0,            ! Type suspension rear "spridler" (always zero)
   IP(5,1)  =,              ! Power flag, rear "spridler"
   IB(5,1)  =,              ! Brake flag, rear "spridler"
   ELL(5)   =,              ! H-pos rear "spridler" wrt hitch
   ZS(5)    =,              ! V-pos centerline rear "spridler" wrt ground
   EFFRAD(5)=,              ! Effective radius rear "spridler" measure from
```

```
                             ! centerline to outher edge of track
 $END
MK48/14,LVS

!<Include 60-character vehicle title as first line of data>
!
! CAMMS/NRMM-II Linear-feature vehicle data              Form: 4 Aug 91
! This is the format and content for the vehicle data required to run the
! linear-feature (gap-crossing) prediction model in the CAMMS/NRMM-II
! system.  The format is FORTRAN Namelist input format.  The specific
! syntax is as documented in the VAX/VMS fortran and is similiar for
! most FORTRAN compilers that implement namelist input.  The actual input
! is handled by an emulator which is coded in standard fortran-77.  An
! extension to the standard syntax is to ignore the "!" and all text
! information following the "!" for the remainder of the input line.
! This file can be used as the skeleton for the actual input data file
! and should read O-K as is.
!      This data should be placed at end of normal NRMM-II vehicle file
! (after the obstacle performance matrix data) to create the complete CAMMS/
! NRMM-II data set.
! <The comment lines from here to just after the vehicle title may be deleted>
!
! Vehicle description:MK48/14,LVS
!
! Project:_____________________________________________________________
!
! Date entered:__3/25_/02   Entered by:______________ Checked by:______________
!
! Updates:_____________________________________________________________
!
 $LFVDAT
! Over-all description:
   IVTYPE=       1, ! 1=wheeled, 2=flex-track, 3=gird-track
   IVCONF=       3, ! if wheeled; 1=4x4, 2=6x6, 3=8x8
                    ! if tracked; 1=Normal, 2=Dozer, 4=Comb. 1&2
   GVW    =  66000, ! Gross vehicle weight {lbs}
   VVCI1 =      36, ! Vehicle 1-pass VCI for fine-grained soils {RCI}
! Geometry:Vegetation
   VLEN    =   456, ! Over-all length {in}
   VWIDTH =     96, ! Over-all width {in}
   VAADEG =     45, ! Approach/departure angle {deg}
   VCLR    =    40, ! Frame end clearance ("clearance line") {in}
   VRR     =  22.7, ! Roadwheel radius ( + track-thickness if tracked) {in}
   VTL     =   319, ! Front-rear ground wheel center-line distance {in}
   VCGF    = 166.7, ! Horizontal-distance C-G to front-wheel center-line {in}
   VCGH    =  38.5, ! Verticle-distance C-G to front-wheel center-line {in}
! Wheeled vehicle additional geometry data
   WHLGWS =    199, ! Distance between wheels of greatest span {in}
   WBCLR  =     24, ! Clearance between wheels of greatest span {in}
! Tracked vehicle additional data
   TRKLEN =       , ! Length of track on ground (one-side) {in}
   TRKWID =       , ! Width of one track (one-side) {in}
   TRKD   =       , ! Hull depth above end clearance line {in}
   KTPAD  =       , ! Track pad code 1=HAS-pads; 0=NO-pads
! Tracked vehicle sprocket/idler configuration for non-dozer (i.e. IVCONF=1,4)
   RR1    =       , ! Sproket/idler radius {in}
   RR2    =       , ! Horizontal-dist. road-wheel ctr. to sproket/idler ctr. {in}
   RR3    =       , ! Verticle-dist. road-wheel ctr. to sproket/idler ctr. {in}
! Swimming/fording characteristics
   VSWIM  =      0, ! Vehicle swim speed (0.=NON-SWIMMER) {mph}
   VFORD  =       , ! Vehicle fording speed (pre-set to 5mph)
   DFLOAT =     60, ! JANE'S Logistics pg519 Veh maximum fording debth{in}
 $ END
```

MK48/14 with Trailer Vehicle File

```
MK48/14,LVS W/M1095 (16.00R21GY-45PSI) 2FEB88 (Mod. 2MAR97, added Engine data)
*************************************************************************
**** 17April02, This file is for the USMC HIMARS project for Randy Jones****
**** the JMTK(SWIMCRIT)information is for the truck ONLY.           ********
**** Does NOT include the JMTK(SWIMCRIT)data for the trailer data   ********
**************************************************************************
Project:R.Jones, 18Apr02, USMC-HIMARS
! Project: Marine Corps, NSWC Stochastic NRMM project
Added:18Apr02, trailer data (M1095)
Changed the TF on 12May97,: Mr.S.FOX E-MAIL new numbers to be used for the
                           :TF, LVS TRACTIVE EFFORT
Modified:Added Engine and Hi&Lo Trans. data
        :Used Engine Data instead of TF I/P it made a small change in the
        :results.
Obsmod:23Apr02 ran the MK48-14 as one unit and the M1095 trl as another unit
      !then I ran the combine program, added WVALS INCHES 300
! File Name:c:vehicles\nrmmii\mk48.dat
File Name:c:\jones02\usmc-himars\vehicles\mk48-14.trl !18Apr02
MK48/14, LVS W/M1095 (16.00R21 GY-45PSI) 2FEB88(Mod. 2MAR97,added Engine data)
$VEHICLE
  NAMBLY= 6,
  WGHT(1)=16550,14625,17225,17600,9550,9550,!18Apr02(7Mar00, trl data from
                                            ! Joe Rouse AEC)
NVUNTS=2,
VULEN(1)= 456,230.5,!Jane's95-96 pg519, LVS(Logistic Veh. System)Form MK 11-85
                   !18Apr02,(7Mar00,trl data from Joe Rouse AEC)
CGH   =61.2,
CGLAT = 0,
CGR   =152.3,
CL    =13,
CLRMIN(1)=13,13,13,13,14.5,14.5, !18Apr02,(7Mar00,trl data from Joe Rouse AEC)
EYEHGT=88,
PBF   =66000,
PBHT  =42,
PFA   =53,        !changed from 39 to 53
! VAA  =45,       !Jane's95-96 pg519, LVS(Logistic Vehicle System)Form MK 11-85
! VDA  =45,       !Jane's95-96 pg519, LVS(Logistic Vehicle System)Form MK 11-85
WDTH  =96,        !Jane's95-96 pg519, LVS(Logistic Vehicle System)Form MK 11-85
  AVGC=990,
  AXLSP(1) =60,199,60,189.86,56, !18Apr02, trl calculated
!  DFLCT(1,1)=2.9,2.9,2.9,2.9,
!  DFLCT(1,2)=,
!  DFLCT(1,3)=,
  DFLCT(1,1)=2.0,2.0,2.0,2.0,2.0,2.0,!HWY,4Apr02, used M977(HEMTT) defl.
                                     !18Apr02, for trl used truck defl.
  DFLCT(1,2)=3.2,3.2,3.2,3.2,3.2,3.2,!cc,4Apr02, used M977(HEMTT) defl.
                                     !18Apr02, for trl used truck defl.
  DFLCT(1,3)=4.3,4.3,4.3,4.3,4.3,4.3,!sand,4Apr02, used M977(HEMTT) defl.
                                     !18Apr02, for trl used truck defl.
  DFLCT(1,4)=4.7,4.7,4.7,4.7,4.7,4.7,!emer,4Apr02, used M977(HEMTT) defl.
                                     !18Apr02, for trl used truck defl.
  DIAW(1)  =51.2,51.2,51.2,51.2,2*46.9,
!  KCTIOP(1)= 8*1,
  KCTIOP(1)= 8*0,          !not a CTI veh., made it CTI for this project
!  NJPSI=1,
!  JVPSI=1,
  NJPSI=4,                 !4Apr02
  JVPSI=2,                 !4Apr02
  ICONST(1)=0,0,0,0,2*0,   !0=Radial
  ID(1)    =0,0,0,0,0,0,   !0=Not Duals
  IT(1)    =1,1,2,2,3,3,   !Tandem,Tandem changed 23Jan.97 from 1,2,1,2
  KTSFLG   =1,1,1,1,1,1,   !Radial
  NCHAIN(1)=0,0,0,0,0,0,   !0=None
  NVEH(1)  =1,1,1,1,1,1,   !1=Wheeled
  NWHL(1)  =2,2,2,2,2,2,   !# of tires per axle
  RDIAM(1) =21,21,21,21,2*20,
  RIMW(1)  =10,10,10,10,2*10,
  SECTH(1) =15.1,15.1,15.1,15.1,2*10.4,
  SECTW(1) =17.1,17.1,17.1,17.1,2*15.4,
  TL=564.86,
  TPLY(1)  =26,26,26,26,2*14,
!  TPSI(1,1)=45,45,45,45,   !hwy
!  TPSI(1,2)=,
!  TPSI(1,3)=,
  TPSI(1,1)=60,60,70,70,60,60,!hwy, 4Apr02, used M977(HEMTT)TPSI
                             !18Apr02,for trl data used truck
  TPSI(1,2)=35,35,40,40,35,35,!CC, 4Apr02, used M977(HEMTT)TPSI
```

```
                                !18Apr02,for trl data used truck
  TPSI(1,3)=20,20,30,30,20,20,!SAND, 4Apr02, used M977(HEMTT)TPSI
                                !18Apr02,for trl data used truck
  TPSI(1,4)=15,15,19,19,15,15,!EMER, 4Apr02, used M977(HEMTT)TPSI
!   VTIRMX(1)=100,100,100,100,
  VTIRMX(1)=60,40,12,5,         !23Apr02
 !  WI=61.9,
  WT(1)     =79,79,79,79,2*80.5,! LVS(Logistic Veh System)MK 11-85 from picture
  WTE(1)    =61.9,61.9,61.9,61.9,2*64,
 CID= 736,                      !LVS(Logistic Vehicle System)Form MK 11-85,
                                !:Detroit Diesel 8V92TA
 ICONV1= ,
 CONV1 =  ,  ,
 ICONV2=  ,
 CONV2 =  ,  ,
! IENGIN=  9,
! ENGINE= 340,   4628,
!         515,   3186,
!         800,   1757,
!         1000,  1673,
!         1180,  1334,
!         1629,  967,
!         1891,  868,
!         2018,  829,
!         2383,  661,
  FD(1) =5.45,0.95,
  HPNET =445,      !Jane's95-96 pg.519,LVS(Logistic Vehicle System)Form MK11-85
 !  IAPG  =  2,
  IB(1) = 1,1,1,1,1,1, !1=Braked
  IDIESL=  2,
  IP(1) =1,1,1,1,0,0,  !1=Powered
 !  ITCASE=  1,
 !  ITRAN =  1,
  ITVAR =  0,
  KTROPR(1) = 8*0,
  LOCDIF=  1,      !1=Yes, Locking differential
  LOCKUP=  1,
  NCYL  =  8,
  NENG  =  1,
  QMAX  =1250,
!   REVM(1) =418,418,418,418,
  REVM(1) =394,394,394,394,447,447,
  TCASE(1)=1.0,1.0,
  TQIND =    ,
!   NGR   =  8,
  NGR   =  4,
  NTRANG = 2,
!   TRANS=9.81,0.95,
!         5.37,0.95,
!         3.69,0.95,
!         3.67,0.95,
!         2.66,0.95,
!         2.02,0.95,
!         1.38,0.95,
!         1.00,0.95,
  TRANS(1,1,1) = 4.28,0.95,
                 2.34,0.95,
                 1.60,0.95,
                 1.16,0.95,
  TRANS(1,1,2) = 7.82,0.95,
                 4.28,0.95,
                 2.92,0.95,
                 2.12,0.95,
!TRACTIVE EFFORT VS SPEED, LVS, 66000 LB, DDA 8V-92, ALLISON HT-740
!REVISED  5/12/97, POWER CURVE FROM E-MAIL, S.FOX
!2.12 DROP BOX RATIO
!                SPEED MPH       TRACTIVE EFFORT LBS
 IPOWER(1)= 30,
 POWER(1,1,1)=0.0,           47936, !*
              1.0,           42162,
              1.46,          39600,
              2.0,           36779,
              3,             30894,
              4,             25943,
              5,             21644,
              6,             19635,
              7,             18014,
              8,             13350,
              9,             12180,
              10,            10202,
              11,            8152,
```

```
                12,             10367,
                13,             9815,
                14,             7619,
                15,             6707,
                16,             7499,
                17,             7290,
                18,             7093,
                19,             6797,
                20,             5083,
                21,             4710,
                22,             4188,
                23,             5321,
                24,             5205,
                25,             5087,
                26,             4943,
                27,             4777,
                27.84,          3113,
!*EXCEEDS  VEHICLE TRACTION LIMIT, POWER CURVE FROM E-MAIL, S.Fox
!1.16  DROP BOX RATIO
!              SPEED MPH       TRACTIVE EFFORT
  IPOWER(2)= 27,
  POWER(1,1,2)=0,               26229,
                2,              22772,
                4,              19524,
                6,              16084,
                8,              13305,
                10,             10119,
                12,             10277,
                14,             7536,
                16,             6816,
                18,             5740,
                20,             4526,
                22,             5663,
                24,             5322,
                26,             4054,
                28,             3501,
                30,             4059,
                32,             3930,
                34,             3783,
                36,             3595,
                38,             2635,
                40,             2325,
                42,             2913,
                44,             2844,
                46,             2771,
                48,             2682,
                50,             2481,
                50.88,          1703,
!   IPOWER= 0,
!   IPOWER= 28,
!   POWER= 0. ,54006,
!          1. ,48770,
!          1.9,43218,
!          2.9,36725,
!          3.8,27820,
!          4.8,24470,
!          5.7,18954,
!          6.7,17442,
!          7.7,15917,
!          8.6,14370,
!          9.5,13334,
!         10.5,12822,
!         12.4,10222,
!         14.4, 9180,
!         16.2, 6986,
!         19.1, 6158,
!         21.9, 5747,
!         23.9, 5275,
!         26.7, 4725,
!         28.6, 3658,
!         33.4, 3442,
!         38.1, 3147,
!         43. , 2510,
!         47.8, 2432,
!         50.6, 2338,
!         52.5, 2233,
!         57.3, 2180,
!         60.2, 2128,
  ACD   =1.0,
  CD    = .7,
  XBRCOF= .8,
```

```
   NHVALS=12,
   HVALS=  0,   7, 7.1, 7.2, 7.5,
           8,   9,  10,  12,  14,
          24,  60,
   VOOB = 60,  60,  20,  11, 7.5,
         5.5,   5, 4.5, 3.5, 2.8,
           2,   2,
 !  NSVALS= 0,
   MAXIPR=14,
   MAXL=   1,
   RMS=            0, .15,  .2, .3,  .4,
                  .5,  .6, .75,  1, 1.5,
                   2,   3,   4,  5,
   VRIDE(1,1,1)= 60,  60,  40, 30, 24.5,
                 21,  18,  15, 13,   11,
                9.5,   8, 6.5,  6,
   VRIDE(1,2,1)=,
   VRIDE(1,3,1)=,
 DRAFT =  ,
 FORDD =  ,
 SAE   =  ,
 SAI   =  ,
 VFS   =  ,
 VSS   =  ,
 VSSAXP=  ,
 WC    =  ,
 NWR   =  ,
 WDAXP =  ,
 WDPTH(1)=  ,
 WRAT(1) =  ,
 WRFORD=  ,
 $END
NOHGT       !23Apr02 1 MK48/14 w/m1095 trailer
     3      !c:\vehicles\nrmmii\obsmod\mk48-14.obv
NANG        !c:\vehicles\nrmmii\obsmod\m1095.obv
     8      !c:\vehicles\nrmmii\obsmod\obwxlwb.dat
NWDTH       !c:\vehicles\nrmmii\obsmod\obmdcomb mk48-14.obo m1095.obo
     4      ! > mk48m10,cmb
```

CLRMIN	FOOMAX	FOO	HOVALS	AVALS	WVALS
INCHES	POUNDS	POUNDS	INCHES	RADIANS	INCHES
9.94	9323.3	354.4	3.15	1.95	5.88
-2.85	28257.6	1822.6	15.75	1.95	5.88
-11.39	54317.2	3949.5	33.46	1.95	5.88
9.94	9323.3	360.2	3.15	2.48	5.88
-1.16	22798.8	1668.0	15.75	2.48	5.88
-4.82	28207.3	2829.6	33.46	2.48	5.88
9.85	8427.8	287.0	3.15	2.69	5.88
2.46	18767.6	1274.5	15.75	2.69	5.88
-4.33	19466.4	2314.1	33.46	2.69	5.88
9.97	5022.3	309.2	3.15	2.86	5.88
5.76	11280.0	896.5	15.75	2.86	5.88
-0.67	11809.2	1545.3	33.46	2.86	5.88
11.58	5049.6	239.1	3.15	3.42	5.88
7.53	7705.4	472.7	15.75	3.42	5.88
7.53	11658.1	1445.5	33.46	3.42	5.88
12.14	6576.7	233.8	3.15	3.60	5.88
6.15	8316.4	585.8	15.75	3.60	5.88
5.52	19429.8	1185.1	33.46	3.60	5.88
12.51	4632.5	72.8	3.15	3.80	5.88
7.61	12594.6	730.1	15.75	3.80	5.88
6.33	12490.6	641.2	33.46	3.80	5.88
12.90	2826.4	12.9	3.15	4.33	5.88
12.40	5377.5	150.7	15.75	4.33	5.88
10.88	11412.8	746.7	33.46	4.33	5.88
9.75	8343.1	242.4	3.15	1.95	29.88
6.20	19763.8	610.8	15.75	1.95	29.88
-9.09	53693.3	1992.9	33.46	1.95	29.88
9.75	8343.1	246.5	3.15	2.48	29.88
6.86	18882.3	956.6	15.75	2.48	29.88
-4.80	28046.1	1637.4	33.46	2.48	29.88
9.85	8427.8	268.5	3.15	2.69	29.88
7.02	15557.3	750.7	15.75	2.69	29.88
-4.25	18704.9	1970.6	33.46	2.69	29.88
9.94	5018.4	220.0	3.15	2.86	29.88
6.85	11269.5	759.9	15.75	2.86	29.88
0.82	11806.7	1404.6	33.46	2.86	29.88
11.57	5050.3	296.3	3.15	3.42	29.88
7.62	11226.2	715.4	15.75	3.42	29.88
7.47	11656.7	1613.5	33.46	3.42	29.88
11.45	8542.5	302.7	3.15	3.60	29.88
6.75	11379.4	580.5	15.75	3.60	29.88

```
  5.32   19646.5    1628.9    33.46     3.60    29.88
 11.50    8269.0     237.1     3.15     3.80    29.88
  6.48   12649.7     690.5    15.75     3.80    29.88
  5.58   28922.9    1042.0    33.46     3.80    29.88
 10.19   12788.4    1033.0     3.15     4.33    29.88
 10.31   15484.3     763.2    15.75     4.33    29.88
  6.23   21760.3     699.6    33.46     4.33    29.88
 10.93    8343.7     188.9     3.15     1.95   141.60
  5.56   18958.1    1087.8    15.75     1.95   141.60
 -8.23   47587.9    1186.5    33.46     1.95   141.60
 10.93    8343.7     191.3     3.15     2.48   141.60
  6.59   19115.6     900.2    15.75     2.48   141.60
  0.83   18624.1    1063.8    33.46     2.48   141.60
 11.09    8428.4     213.5     3.15     2.69   141.60
  6.82   18777.7     776.5    15.75     2.69   141.60
  5.20   12464.7    1108.4    33.46     2.69   141.60
 11.00    5000.9     180.1     3.15     2.86   141.60
  6.93    7659.7     583.1    15.75     2.86   141.60
  7.91    9255.7     927.6    33.46     2.86   141.60
 11.11    5029.7     214.6     3.15     3.42   141.60
  7.61   11127.4     933.3    15.75     3.42   141.60
  7.41   11654.0    1094.5    33.46     3.42   141.60
 11.17    8461.4     214.1     3.15     3.60   141.60
  5.64   12518.6    1000.9    15.75     3.60   141.60
  3.35   19621.3    1563.9    33.46     3.60   141.60
 10.96    7806.6     183.0     3.15     3.80   141.60
  5.36   18427.4    1076.3    15.75     3.80   141.60
 -6.93   29597.3    1857.7    33.46     3.80   141.60
 11.08    7828.3     131.0     3.15     4.33   141.60
  5.47   14842.8     654.2    15.75     4.33   141.60
 -7.71   35106.9    1971.5    33.46     4.33   141.60
 11.07    5808.6     101.8     3.15     1.95   300.00
  5.38   16229.1     446.8    15.75     1.95   300.00
 -1.04   35006.3    1296.4    33.46     1.95   300.00
 11.07    5808.6     102.8     3.15     2.48   300.00
  5.25   13820.4     573.4    15.75     2.48   300.00
  2.54   29736.1    1449.9    33.46     2.48   300.00
 11.17    8477.0     128.7     3.15     2.69   300.00
  5.62   12464.7     652.1    15.75     2.69   300.00
  5.51   19683.8    1422.4    33.46     2.69   300.00
 11.11    5026.9      87.9     3.15     2.86   300.00
  7.54    9852.2     616.7    15.75     2.86   300.00
  7.42   11654.2    1232.4    33.46     2.86   300.00
 11.09    5023.4     182.9     3.15     3.42   300.00
  7.48    7660.8     640.1    15.75     3.42   300.00
  7.59   11659.6    1219.5    33.46     3.42   300.00
 11.17    8460.4     177.0     3.15     3.60   300.00
  5.45    8583.3     560.0    15.75     3.60   300.00
  5.56   19682.5    1325.8    33.46     3.60   300.00
 10.97    8192.9     117.6     3.15     3.80   300.00
  5.25   20759.2     619.6    15.75     3.80   300.00
 -3.15   29496.5     939.4    33.46     3.80   300.00
 11.23    8827.0     161.1     3.15     4.33   300.00
  4.81   27969.0     777.2    15.75     4.33   300.00
 -6.31   42735.8    1645.2    33.46     4.33   300.00
MK48/14, 14May97
$VEHICL
! I ran this veh as one unit and then ran the m1095trl as one unit, then I ran the
!  combine program
! RB.Ahlvin WES/MSD 24Nov93
! Comments: can't use comments before the $VEHICL line.
!         : use only after the $VEHICL line
  NUNITS =  1,     ! Number of units
  NSUSP  =  2,     ! Number of suspension supports
  NVEH1  =  1,     ! Vehicle type; 0=tracked, 1=wheeled
  NFL    =  0,     ! Track type; 0=rigid, 1=flexible
  REFHT1 = 41.5,   ! Height of hitch from ground
  HTCHFZ =     0,  ! V-force on hitch
  SFLAG(1) = 1,1,  ! Type susp @supt-i,0=indp,1=bogie
! Power flags ((IP(i,j), i=1,nsusp) j=1,2)
  IP(1,1)  =1,1,0,0,0,  !26April99, corrected
  IP(1,2)  =1,1,0,0,0,
! Brake flags ((IB(i,j), i=1,nsusp) j=1,2)
  IB(1,1)  = 1,1,0,0,0, !26April99, corrected
  IB(1,2)  = 1,1,0,0,0,
  EFFRAD(1)=25.6, 25.6,!Effective loaded radius wheels/plus trk thickness wrt ground
  ELL(1)    = 346.8,87.7,         !Horiz. pos. suspension WRT hitch
  BWIDTH(1)=60,60,      !Bogie arm length (centerline wheel to centerline wheel)
  BALMU(1) =  6,12                !Bogie max CCW. angl, (+=CCW.)
  BALMD(1) =-12,-6,               !Bogie max CW. angl, (+=CCW.)
  EQUILF(1)= 31175, 34825,       !Equilibrium force
```

```
CGZ1     =    61.2,       ! V-cg, Unit-1 wrt ground
CGZ2     =  0             ! V-cg, Unit-2 wrt ground
DEE1     =  0             ! H-cg, Unit-1 payload wrt hitch
ZEE1     =  0             ! V-cg, Unit-1 payload wrt ground
DEE2     =  0             ! H-cg, Unit-2 payload wrt hitch
ZEE2     =  0             ! V-cg, Unit-2 payload wrt ground
DELTW1   =  0             ! Payload weight, Unit-1
DELTW2   =  0             ! Payload weight, Unit-2
NPTSC1   = 16,            ! #Pts, bottom profile, Unit-1
XCLC1(1) =  452,   452,   429,  406,  356,   !Unit-1
            347,   292,   271,  213,  149,
          101.0,  90.0,  30.0,   10,    0,
           -9.2,
YCLC1(1) = 69.7,    60,    36,   36, 16.6,   !Unit-1
           16.6,    21,    31, 29.5,   28,
           12.9,  12.9,    35,   35, 41.5,
             61,
NPTSC2   =,!#Pts, bottom prof.
XCLC2(1) =,
YCLC2(1) =,
SFLAG(4) = 0,            ! Type suspension front "spridler" (always zero)
IP(4,1)  =,              ! Power flag, front "spridler"
IB(4,1)  =,              ! Brake flag, front "spridler"
ELL(4)   =,              ! H-pos front "spridler" wrt hitch
ZS(4)    =,              ! V-pos centerline front "spridler" wrt ground
EFFRAD(4)=,              ! Effective radius front "spridler" measure from
                         ! centerline to outher edge of track
SFLAG(5) = 0,            ! Type suspension rear "spridler" (always zero)
IP(5,1)  =,              ! Power flag, rear "spridler"
IB(5,1)  =,              ! Brake flag, rear "spridler"
ELL(5)   =,              ! H-pos rear "spridler" wrt hitch
ZS(5)    =,              ! V-pos centerline rear "spridler" wrt ground
EFFRAD(5)=,              ! Effective radius rear "spridler" measure from
                         ! centerline to outher edge of track
$END
M1095(trler only)made trl with wheel under the trl tongue,made all power 22Apr2
$VEHICL
! 22April02 made this a fake veh. with power
! RB.Ahlvin WES/MSD 24Nov93
! Comments: can't use comments before the $VEHICL line.
!          : use only after the $VEHICL line
  NUNITS =  1,     ! Number of units
  NSUSP  =  2,     ! Number of suspension supports
  NVEH1  =  1,     ! Vehicle type; 0=tracked, 1=wheeled
  NFL    =  0,     ! Track type; 0=rigid, 1=flexible
  REFHT1 = 34,     ! Height of hitch from ground
  HTCHFZ =     0,  ! V-force on hitch
  SFLAG(1) = 0,1, ! Type susp @supt-i,0=indp,1=bogie
! Power flags ((IP(i,j), i=1,nsusp) j=1,2)
  IP(1,1)  =1,0,0,0,0,  !26April99, corrected
  IP(1,2)  =1,0,0,0,0,
! Brake flags ((IB(i,j), i=1,nsusp) j=1,2)
  IB(1,1)  = 1,0,0,0,0, !26April99, corrected
  IB(1,2)  = 1,0,0,0,0,
  EFFRAD(1)=23.45,23.45,   !Eff. loaded radius whls
  ELL(1)   =0 -163,     !Horiz. pos. suspension WRT hitch
  BWIDTH(1)=0, 56   !Bogie arm length (centerline wheel to centerline wheel)
  BALMU(1) =  0, 10,            !Bogie max CCW. angl, (+=CCW.)
  BALMD(1) =  0,-10,            !Bogie max CW. angl, (+=CCW.)
  EQUILF(1)= 9550,9550,         !Equilibrium force
  CGZ1     =     60.1,          ! V-cg, Unit-1 wrt ground
  CGZ2     =  0,            ! V-cg, Unit-2 wrt ground
  DEE1     =  0,            ! H-cg, Unit-1 payload wrt hitch
  ZEE1     =  0,            ! V-cg, Unit-1 payload wrt ground
  DEE2     =  0,            ! H-cg, Unit-2 payload wrt hitch
  ZEE2     =  0,            ! V-cg, Unit-2 payload wrt ground
  DELTW1   =  0,            ! Payload weight, Unit-1
  DELTW2   =  0,            ! Payload weight, Unit-2
  NPTSC1   =  8,           ! #Pts, bottom profile, Unit-1
  XCLC1(1) = 0,   -16,   -16, -223,  -223,     !Unit-1
           -228,   -228, -230.6,
  YCLC1(1) =34,     34,   37,    37,    26,     !Unit-1
             26,     40,   40,
  NPTSC2   =,              !#Pts, bottom prof.
  XCLC2(1) =,
  YCLC2(1) =,
  SFLAG(4) = 0,             ! Type suspension front "spridler" (always zero)
  IP(4,1)  =,               ! Power flag, front "spridler"
  IB(4,1)  =,               ! Brake flag, front "spridler"
  ELL(4)   =,               ! H-pos front "spridler" wrt hitch
  ZS(4)    =,               ! V-pos centerline front "spridler" wrt ground
```

```
  EFFRAD(4)=,             ! Effective radius front "spridler" measure from
                          ! centerline to outher edge of track
  SFLAG(5) = 0,           ! Type suspension rear "spridler" (always zero)
  IP(5,1)  =,             ! Power flag, rear "spridler"
  IB(5,1)  =,             ! Brake flag, rear "spridler"
  ELL(5)   =,             ! H-pos rear "spridler" wrt hitch
  ZS(5)    =,             ! V-pos centerline rear "spridler" wrt ground
  EFFRAD(5)=,             ! Effective radius rear "spridler" measure from
                          ! centerline to outher edge of track
 $END
************************************************************************
 **** 17April02, This file is for the USMC HIMARS project for Randy Jones****
 **** the JMTK(SWIMCRIT)information is for the truck ONLY.         ********
 **** Does NOT include the JMTK(SWIMCRIT)data for the trailer data   ********
 ************************************************************************
MK48/14,LVS
____________________________________________________________
!<Include 60-character vehicle title as first line of data>
!
! CAMMS/NRMM-II Linear-feature vehicle data              Form: 4 Aug 91
! This is the format and content for the vehicle data required to run the
! linear-feature (gap-crossing) prediction model in the CAMMS/NRMM-II
! system.  The format is FORTRAN Namelist input format.  The specific
! syntax is as documented in the VAX/VMS fortran and is similiar for
! most FORTRAN compilers that implement namelist input.  The actual input
! is handled by an emulator which is coded in standard fortran-77.  An
! extension to the standard syntax is to ignore the "!" and all text
! information following the "!" for the remainder of the input line.
! This file can be used as the skeleton for the actual input data file
! and should read O-K as is.
!      This data should be placed at end of normal NRMM-II vehicle file
! (after the obstacle performance matrix data) to create the complete CAMMS/
! NRMM-II data set.
! <The comment lines from here to just after the vehicle title may be deleted>
!
! Vehicle description:MK48/14,LVS
!
! Project:__________________________________________________________________
!
! Date entered:__3/25_/02   Entered by:______________ Checked by:______________
!
! Updates:__________________________________________________________________
!
 $LFVDAT
! Over-all description:
  IVTYPE=       1, ! 1=wheeled, 2=flex-track, 3=gird-track
  IVCONF=       3, ! if wheeled; 1=4x4, 2=6x6, 3=8x8
                   ! if tracked; 1=Normal, 2=Dozer, 4=Comb. 1&2
  GVW    =  66000, ! Gross vehicle weight {lbs}
  VVCI1 =      36, ! Vehicle 1-pass VCI for fine-grained soils {RCI}
! Geometry:Vegetation
  VLEN   =    456, ! Over-all length {in}
  VWIDTH =     96, ! Over-all width {in}
  VAADEG =     45, ! Approach/departure angle {deg}
  VCLR   =     40, ! Frame end clearance ("clearance line") {in}
  VRR    =   22.7, ! Roadwheel radius ( + track-thickness if tracked) {in}
  VTL    =    319, ! Front-rear ground wheel center-line distance {in}
  VCGF   =  166.7, ! Horizontal-distance C-G to front-wheel center-line {in}
  VCGH   =   38.5, ! Verticle-distance C-G to front-wheel center-line {in}
! Wheeled vehicle additional geometry data
  WHLGWS =    199, ! Distance between wheels of greatest span {in}
  WBCLR  =     24, ! Clearance between wheels of greatest span {in}
! Tracked vehicle additional data
  TRKLEN =       , ! Length of track on ground (one-side) {in}
  TRKWID =       , ! Width of one track (one-side) {in}
  TRKD   =       , ! Hull depth above end clearance line {in}
  KTPAD  =       , ! Track pad code 1=HAS-pads; 0=NO-pads
! Tracked vehicle sprocket/idler configuration for non-dozer (i.e. IVCONF=1,4)
  RR1    =       , ! Sproket/idler radius {in}
  RR2    =       , ! Horizontal-dist. road-wheel ctr. to sproket/idler ctr. {in}
  RR3    =       , ! Verticle-dist. road-wheel ctr. to sproket/idler ctr. {in}
! Swimming/fording characteristics
  VSWIM  =      0, ! Vehicle swim speed (0.=NON-SWIMMER) {mph}
  VFORD  =       , ! Vehicle fording speed (pre-set to 5mph)
  DFLOAT =     60, ! JANE'S Logistics pg519 Veh maximum fording debth{in}
 $ END
```

MTVR XLWB Vehicle File

```
OSHKOSHXLWB, 7.1Ton payload
W/Winch,2Nov98,29Oct98,27Oct98,23Oct98,13Oct98,1Oct98,28Sep98,25Sep98,10Sep98,3Sep98,
8Jul98,22Jun98,15Jun98
 Project:R.Jones, 17Apr02, USMC HIMARS
 !VEH1, 2April98
 Chaned: 1May02, PBF to loaded weight
 Modified,  2Nov98: from NRMMII Data Sheet's XLWB, 8/30/98
                    Converted to an extra long wheel base
                    WGHT, NRMMII Sheet BW1a,xlwb,8/30/98
                   AXLSP, NRMMII Sheet BW1a,xlwb,8/30/98
                     CGH, NRMMII Sheet HW1a,xlwb,8/30/98
                     CGR, Calculated 2Nov98
                     PBF, NRMMII Sheet JHWY 8/30/98
                      CL, NRMMII Sheet HW1a,xlwb,8/30/98
                    PBHT, NRMMII Sheet HWVa,xlwb,8/30/98
                      TL, NRMMII Sheet HWVa,xlwb,8/30/98
                   VULEN, NRMMII Sheet HW1a,xlwb,8/30/98
                   DFLCT, NRMMII Sheet BW1c,xlwb,8/30/98
                   CONV2, NRMMII Sheet POWb,xlwb,8/30/98
                  ENGINE, NRMMII Sheet POWc,xlwb,8/30/98
                   POWER, NRMMII Sheet POWf,xlwb,8/30/98
                   FORDD, NRMMII Sheet WCR1,xlwb,8/30/98
                  REFHT1, NRMMII Sheet HWVa,xlwb,8/30/98
                  EFFRAD, NRMMII Sheet HWVb,xlwb,8/30/98
                     ELL, NRMMII Sheet HWVb,xlwb,8/30/98
                  EQUILF, NRMMII Sheet BW1a,xlwb,8/30/98
                    CGZ1, NRMMII Sheet HWVa,xlwb,8/30/98
                   XCLC1, NRMMII Sheet HPRF,xlwb,8/30/98
                   YCLC1, NRMMII Sheet HPRF,xlwb,8/30/98
 Modified, 2Nov98: Dan Creighton 9Nov98, VEDYNII results, for XLong Wheel Base
                    HVALS
                    VOOB
                    RMS
                    VRIDE
 Modified, 27Oct98, from IFD's OTC-T-044, 9/21/98
                    CGZ1, Used CGH,loaded Wght.,because missing variables
                    DEE1,ZEE1, Missing
                    SFLAG, NRMMII Sheet HWVb, OTC-T-044, 9/21/98
                    EFFRAD,NRMMII Sheet HWVb, OTC-T-044, 9/21/98
                    ELL, NRMMII Sheet HWVb, OTC-T-044, 9/21/98
                    BALMD, Changed to negative
                    EQUILF, Used loaded Wght.,because missing variales
 Modified, 23Oct98, Created a new Obsmod file, Data from
                    Drawing,calculated,Est.
                    NRMMII Data Sheet HWVa,HWVb 8/30/98 information MISSING
 Modified, 13Oct98, RDIAM, NRMMII Data Sheet BW1a 9/30/98
                    CGH,CGR,DEFL CC, MTVR PHASEII-184-56.5-CAT 9/30/98
 Modified, 10Sept98, HROSUS
 Modified, 3Sept98, from NRMMII Data Sheet's 8/30/98
 Modified, 8July98 6-Watt Ride Curve, Data from VEDYNII Model
 Modified, 22June98 6-Watt Ride Curve,Data from(RFP 6-10-96,per R.Jones
          :22June98
 Modified, 15June98 6-Watt Ride Curve,Data from (MTTRDYNAMICS_3-19-98.PPT)
          :MTTR Program(Performance Testing)TARDEC
          :The only change was the 6-Watt Ride Curve
 Project:Randy Jones, 2April98
! File Name: c:\jones-98\mttr-4\nrmm259b\vehs\veh1.dat    !2April98
!  File Name: c:\jones-98\mttr-4\nrmm259b\vehs\OSHKOSH.DAT !22June98
                                                          !6-Watt Ride Curve change
                                                          !********************
                                                          !15June98
                                                          !The only change was
                                                          !the 6-Watt Ride Curve
! File Name:c:\jones-98\mttr-7\vehs\oshkosh.dat!8July98 VEHDYN2 6-Watt Ride Curve
! File Name:c:\jones-98\mttr-9\PHASE2\vehs\oshkosh.dat!ModNRMMII Data Sheet8/30/98
!                                                     !10Sept98 Mod HROSUS 9Sept98
! File Name:c:\jones-98\mttr-9\PHASE2\vehs\oshhrosu.dat !10Sept98 used original
                                                          !HROSUS=-16.7
! File Name:c:\jones-98\mttr-9\PHASE2\vehs\osh257.dat !6Oct.98, to run NRMM257
! File Name:c:\jones-98\mttr-9\PHASE2\vehs\oshxlwb.dat !2Nov98 w/exlong whl base
 File Name:c:\jones02\usmc-himars\vehicles\oshxlwb.trl !17Apr02 added M1095 trl
 OSHKOSHXLWB 7.1Ton payload
W/Winch,2Nov98,29Oct98,27Oct98,23Oct98,13Oct98,1Oct98,28Sep98,25Sep98,10Sep98,3Sep98,
8Jul98,22Jun98,15Jun98
 $VEHICLE
!
!  General Characteristics
!
```

```
  NAMBLY     = 3,
!  WGHT(1)    = 12311, 13706, 13706,
!  WGHT(1)    = 12472, 16002, 15846,      !OTC FEB98,NRMMII Sheet BW1a 1/29/98
!  WGHT(1)    = 13014, 15160, 15116,      !3Sept98, NRMMII Sheet BW1a 8/30/98
  WGHT(1)    = 13228, 16131, 16305,  !2Nov98, NRMMII Sheets BW1a XLWB, 8/30/98
  NVUNTS     = 1,
  NSUSP      = 3,
!  RAID(1)    = 780., 1121., 1121.,
  RAID(1)    = 662.4, 1053.4, 1053.4,  !2April98, NRMMII Data Sheet BW1g 1/29/98
!  HROSUS(1) = 16.1, 16.1, 16.1,        !value is positive because of a roll bar
!  HROSUS(1) = -16.7, -16.7, -16.7,     !2April98, NRMMII Data Sheets BW1a 1/29/98
  HROSUS(1) =  11.4, 11.4, 11.4,       !10Sept98, from NATC 9/4/98
                                       !:NRMMII Sheet BW1a XLWB 8/30/98
  VSLIMX     = 0.0,
  VTIPMX     = 0.0,
!
!  Vehicle Geometry
!
! AXLSP(1)   = 156.3, 56.0,
! AXLSP(1)   = 155.75, 56.50,          !OTC FEB98
                                       !:NRMMII Data Sheet's BW1a 8/30/98
 AXLSP(1)   = 187.75, 56.50,     !2Nov98 OTC-T-053,XLWB 10/29/98
! CGH        = 55.9,
! CGH        = 55.41,                  !changed to agree with Vehdyn/DADS #'s
! CGH        = 55.8,                   !2April98,NRMMII Sheet HWVa 1/29/98,8/30/98
! CGH        = 55.5,                   !13Oct98, MTVR PHASEII-184-56.5-CAT,9/30/98
 CGH        = 55.8,              !2Nov98 NRMMII Sheet HWVa XLWB 8/30/98
 CGLAT      = 0,                       !NRMMII Data Sheet HWVa 8/30/98
! CGR        = 83.1,
! CGR        = 83.8,                   !changed to agree with Vehdyn/DADS #'s
! CGR        = 83.3,                   !13Oct98 MTVR PHASEII-184-56.5-CAT,9/30/98
 CGR        = 90.7,              !2Nov98, calculated
! CL         = 17.,
! CLRMIN(1) = 17., 17., 17.,
! CL         = 16.2,                   !used value from technical proposal
! CL         = 20.8,                   !2April98,NRMMII Data Sheets HWVa 1/29/98
 CL         = 20.3,              !2Nov98 NRMMII Sheet HWVa XLWB 8/30/98
! CLRMIN(1) = 16.2, 16.2, 16.2,        !used value from technical proposal
 CLRMIN(1) = 16.45, 16.73, 16.83,      !2April98,NRMMII Data Sheets BW1a 1/29/98
! EYEHGT     = 100.4,
 EYEHGT     = 105.5,                   !OTC FEB98 NRMMII Data Sheet HWVa 8/30/98
! PBF        = 40750,
! PBF        = 44320,                  !OTC FEB98
! PBF        = 40750,                  !2April98,NRMMII Data Sheets JHWY 1/29/98
! PBF        = 43290,                  !3Sept98,NRMMII Data Sheets A 8/30/98
! PBF        = 40750,                  !25Sept98,NRMMII Sheet JHWY XLWB 8/30/98
!  PBF        = 31064,           !2Nov98 Curb wght.,NRMMII Sheet JHWY,8/30/98
 PBF        = 45664,             !1May02, loaded weight
! PBHT       = 48.,
! PBHT       = 36.4,                   !OTC FEB98,NRMMII Data Sheet HWVa 8/30/98
 PBHT       = 36.8,              !2Nov98 NRMMII Sheet HWVa XLWB 8/30/98
 PFA        = 69.0,                    !NRMMII Data Sheet JHWY 8/30/98
! TL         = 212.25,                 !NRMMII Data Sheet HWVa 8/30/98
 TL         = 244.25,            !2Nov98 NRMMII Sheet HWVa 8/30/98
 WDTH       = 97.4,                    !NRMMII Data Sheet HWVa 8/30/98
! VULEN(1)  = 311.3,
! VULEN(1)  = 319.6,                   !OTC FEB98, NRMMII Data Sheet HWVa 8/30/98
 VULEN(1)  = 386.5,              !2Nov98 NRMMII Sheet HWVa 8/30/98
!
!  Tire characteristics, Tire data supplied by Michelin
!
!   AVGC        = 681,
   AVGC        =  800,                 !2Apil98,NRMMII Sheet JHWY 1/29/98,8/30/98
!   DFLCT(1,1) = 2.46, 2.46, 2.46,
!   DFLCT(1,2) = 3.13, 3.13, 3.13,
!   DFLCT(1,3) = 4.61, 4.61, 4.61,
!   DFLCT(1,4) = 5.39, 5.39, 5.39,
!***Special Note Vendor indicated total wght of each axle, for each dflct,***
!*** NRMMII Data Sheets BW1d, 2April98 *********************
!   DFLCT(1,1) = 2.23, 2.24, 2.22, !2April98,HWY  NRMMII Data Sheets BW1c 1/29/98
!   DFLCT(1,2) = 3.12, 3.17, 3.14, !2April98,CC   NRMMII Data Sheets BW1c 1/29/98
!   DFLCT(1,3) = 4.30, 4.62, 4.62, !2April98,MSS  NRMMII Data Sheets BW1c 1/29/98
!   DFLCT(1,4) = 4.60, 5.21, 5.24, !2April98,EM'C NRMMII Data Sheets BW1c 1/29/98
!   DFLCT(1,1) = 2.36, 2.13, 2.13, !3Sept98,HWY  NRMMII Data Sheets BW1c 8/30/98
!   DFLCT(1,2) = 3.24, 3.04, 3.03, !3Sept98,CC   NRMMII Data Sheets BW1c 8/30/98
!   DFLCT(1,2) = 3.24, 3.02, 3.01, !13Oct98,CC MTVR PHASEII-184-56.5-CAT,9/30/98
!   DFLCT(1,3) = 4.47, 4.42, 4.41, !3Sept98,MSS  NRMMII Data Sheets BW1c 8/30/98
!   DFLCT(1,3) = 4.47, 4.54, 4.52, !25Sept98,MSS  NRMMII Data Sheets BW1c 8/30/98
!   DFLCT(1,4) = 4.78, 5.00, 4.99, !3Sept98,EM'C NRMMII Data Sheets BW1c 8/30/98
   DFLCT(1,1)  = 2.23,2.26,2.28, !2Nov98 NRMMII Sheet BW1c,XLWB 8/30/98
   DFLCT(1,2)  = 3.29,3.21,3.24, !2Nov98 NRMMII Sheet BW1c,XLWB 8/30/98
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   DFLCT(1,3)   = 4.54,4.80,4.84, !2Nov98 NRMMII Sheet BW1c,XLWB 8/30/98
   DFLCT(1,4)   = 4.85,5.29,5.33, !2Nov98 NRMMII Sheet BW1c,XLWB 8/30/98
   DIAW(1)      = 52.9, 52.9, 52.9,         !NRMMII Data Sheet's BW1b 8/30/98,9/30/98
   ICONST(1)    = 3*0,                      !NRMMII Data Sheet's BW1b 8/30/98,9/30/98
   ID(1)        = 0, 0, 0,                  !NRMMII Data Sheet's BW1a 8/30/98
   IT(1)        = 0, 0, 0,                  !NRMMII Data Sheet's BW1a 8/30/98
! changed CTIS scenario so all contractor use same
   KCTIOP(1)    = 0, 0, 0, 0,               !CTIS tire operating scenario
                  0, 0, 0, 0,               !0=compute internally
!   KCTIOP(1)   = 1, 1, 3, 2,
!                 2, 3, 2, 3,
   KTSFLG(1)    = 1, 1, 1,              !NRMMII Data Sheet's BW1b 8/30/98
!   JVPSI       = 6,                    !2April98,NRMMII Data Sheets BW1f 1/29/98
   JVPSI        = 2,                    !I changed JVPSI from 6 to 2,
                                        !because we don't have JVPSI=6
                                        !I set JVPSI=2 for Cross Country DFLCT
   NCHAIN(1)    = 0, 0, 0,              !NRMMII Data Sheet's BW1a 8/30/98
   NJPSI        = 4,
   NVEH(1)      = 1, 1, 1,
   NWHL(1)      = 2, 2, 2,               !NRMMII Data Sheet's BW1a 8/30/98
!  RDIAM(1)     = 22., 22., 22.,         !NRMMII Data Sheet's BW1b 8/30/98
   RDIAM(1)     = 20., 20., 20.,         !9Oct98, NRMMII Sheet BW1b 9/30/98,9/30/98
   RW(1)        = 23.3, 23.3, 23.3,
   RIMW(1)      = 10.0, 10.0, 10.0,         !NRMMII Sheet BW1b 8/30/98,9/30/98
   SECTH(1)     = 13.4, 13.4, 13.4,         !NRMMII Data Sheet BW1b 8/30/98,9/30/98
   SECTW(1)     = 17.2, 17.2, 17.2,         !NRMMII Data Sheet BW1b 8/30/98,9/30/98
   TIREID       ='Michelin 425/95 R20 XZL', !NRMMII Data Sheet BW1b 8/30/98,9/30/98
   TPLY(1)      = 22., 22., 22.,            !NRMMII Data Sheet BW1b 8/30/98
!   TPSI(1,1)   = 43., 46., 46.,
!   TPSI(1,1)   = 41., 53., 53.,            !changed per OTC IFD-T-65
!   TPSI(1,2)   = 27., 31., 31.,
!   TPSI(1,2)   = 26., 38., 38.,            !changed per OTC IFD-T-65
!   TPSI(1,3)   = 14., 16., 16.,
!   TPSI(1,3)   = 14., 18., 18.,           !changed per OTC IFD-T-65
!   TPSI(1,4)   = 11., 12., 12.,
   TPSI(1,1)   = 41., 57., 57., !2April98 NRMMII Data Sheets BW1e 1/29/98 8/30/98
   TPSI(1,2)   = 26., 35., 35., !2April98 NRMMII Data Sheets BW1e 1/29/98 8/30/98
!   TPSI(1,3)  = 14., 20., 20.,      !2April98,mss NRMMII Data Sheets BW1e 1/29/98
   TPSI(1,3)   = 14., 19., 19., !25Sept98 NRMMII Data Sheets BW1e 8/30/98
   TPSI(1,4)   = 11., 15., 15., !2April98 NRMMII Data Sheets BW1e 1/29/98 8/30/98
!   VTIRMX(1)  = 55, 40, 20, 9, !NRMMII Data Sheet's BW1f 8/30/98
   VTIRMX(1)   = 60,40,12,5, !23Apr02, R.Jones project USMC HIMARS
!   VTIRMX(1) = 75, 40, 20, 9, !1Oct.98 changed 55 to 75 for the TRAVERSE Model
                               !per R.Jones
   WT(1)       = 80.75, 80.75, 80.75,  !NRMMII Sheet BW1a, XLWB 8/30/98
   WTE(1)      = 61.25, 61.25, 61.25,  !NRMMII Sheet BW1a, XLWB 8/30/98
!
!  Powertrain characteristics
!
 CID(1) = 729,                  !Caterpillar C 12, NRMMII Sheet POWa 8/30/98
!
 ICONV1     = 22,
! CONV1(1,1) = 1565, 0,
!              1594, 0.1,
!              1613, 0.2,
!              1647, 0.3,
!              1675, 0.4,
!              1700, 0.472,
!              1711, 0.5,
!              1752, 0.595,
!              1754, 0.6,
!              1791, 0.7,
!              1819, 0.75,
!              1845, 0.8,
!              1878, 0.85,
!              1930, 0.89,
!              1983, 0.9,
!              2041, 0.9115,
!              2100, 0.9224,
!              2102, 0.9237,
!              2104, 0.9250,
!              2129, 0.94,
!              2146, 0.95,
!              2170, 0.96;
! ICONV2     = 22,
! CONV2(1,1) = 1.864, 0,
!              1.758, 0.1,
!              1.673, 0.2,
!              1.603, 0.3,
!              1.525, 0.4,
!              1.456, 0.4715,
```

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!               1.425, 0.5,
!               1.315, 0.5954,
!               1.310, 0.6,
!               1.195, 0.7,
!               1.134, 0.75,
!               1.076, 0.8,
!               1.013, 0.85,
!               0.9766, 0.89,
!               0.9674, 0.9,
!               0.9643, 0.9115,
!               0.9634, 0.9224,
!               0.9616, 0.9237,
!               0.9598, 0.9250,
!               0.9515, 0.94,
!               0.9453, 0.95,
!               0.9272, 0.96,
!
 ICONV1     =22,                    !2April98,NRMMII Data Sheets POWb 1/29/98,8/30/98
 CONV1(1,1) = 1575, 0.00,
              1603, 0.10,
              1622, 0.20,
              1656, 0.30,
              1685, 0.40,
              1709, 0.47,
              1720, 0.50,
              1761, 0.60,
              1764, 0.60,
              1801, 0.70,
              1829, 0.75,
              1855, 0.80,
              1889, 0.85,
              1940, 0.89,
              1993, 0.90,
              2046, 0.91,
              2100, 0.92,
              2103, 0.92,
              2106, 0.93,
              2131, 0.94,
              2148, 0.95,
              2172, 0.96,
! ICONV2= 18,                               !2April98, NRMMII Data Sheets POWb 1/29/98
! CONV2(1,1)= 1.897, 0.00 ,
!              1.790, 0.10 ,
!              1.704, 0.20 ,
!              1.644, 0.30 ,
!              1.553, 0.40 ,
!              1.462, 0.50 ,
!              1.341, 0.60 ,
!              1.221, 0.70 ,
!              1.157, 0.75 ,
!              1.105, 0.80 ,
!              1.048, 0.85 ,
!              1.00 , 0.89 ,
!              1.00 , 0.89 ,
!              1.00 , 0.90 ,
!              1.00 , 0.925,
!              1.00 , 0.94 ,
!              1.00 , 0.95 ,
!              1.00 , 0.96 ,
! ICONV2= 18,                           !3Sept98, NRMMII Data Sheets POWb 8/30/98
! CONV2(1,1)=   1.85 , 0.00 ,
!               1.75 , 0.10 ,
!               1.66 , 0.20 ,
!               1.59 , 0.30 ,
!               1.51 , 0.40 ,
!               1.41 , 0.50 ,
!               1.31 , 0.60 ,
!               1.19 , 0.70 ,
!               1.13 , 0.75 ,
!               1.07 , 0.80 ,
!               1.01 , 0.85 ,
!               0.95 , 0.89 ,
!               0.95 , 0.89 ,
!               0.96 , 0.90 ,
!               0.96 , 0.925,
!               0.94 , 0.94 ,
!               0.94 , 0.95 ,
!               0.92 , 0.96 ,
  ICONV2= 22,                           !2Nov98, NRMMII Sheet POWb XLWB 8/30/98
  CONV2(1,1)=   1.85 , 0.00 ,
                1.75 , 0.10 ,
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                  1.66 , 0.20 ,
                  1.59 , 0.30 ,
                  1.51 , 0.40 ,
                  1.45 , 0.47 ,
                  1.42 , 0.50 ,
                  1.31 , 0.595,
                  1.30 , 0.60 ,
                  1.19 , 0.70 ,
                  1.13 , 0.75 ,
                  1.07 , 0.80 ,
                  1.01 , 0.85 ,
                  0.95 , 0.89 ,
                  0.96 , 0.90 ,
                  0.96 , 0.91 ,
                  0.96 , 0.92 ,
                  0.96 , 0.92 ,
                  0.96 , 0.93 ,
                  0.94 , 0.94 ,
                  0.94 , 0.95 ,
                  0.92 , 0.96 ,
  ! IENGIN      = 9,
!
! ENGINE(1,1) = 1200, 1320.,
!               1300, 1300.,
!               1400, 1261.,
!               1500, 1208.,
!               1600, 1142.,
!               1700, 1064.,
!               1900, 921.,
!               2100, 765.,
!               2300, -183., !*this looks weird, can leave in talked to R.Ahlvin
!
! ENGINE(1,1) = 1200, 1351.,          !2April98, NRMMII Data Sheets POWc 1/29/98
!               1300, 1330.,          !Torque
!               1400, 1291.,
!               1500, 1237.,
!               1600, 1169.,
!               1700, 1090.,
!               1900, 944.,
!               2100, 785.,
!               2300, -183., !*this looks weird, can leave in talked to R. Ahlvin
! IENGIN      = 10,
! ENGINE(1,1) = 1060, 1356.,         !3Sept98, NRMMII Data Sheets POWc 8/30/98
!               1200, 1325.,
!               1300, 1303.,
!               1400, 1264.,
!               1500, 1209.,
!               1600, 1141.,
!               1700, 1062.,
!               1900,  915.,
!               2100,  755.,
!               2150,  496.,
 IENGIN      = 12,
 ENGINE(1,1) = 1060, 1356.,         !2Nov98, NRMMII Sheets POWc XLWB 8/30/98
               1200, 1325.,
               1300, 1303.,
               1400, 1264.,
               1500, 1209.,
               1600, 1141.,
               1700, 1062.,
               1900,  915.,
               2100,  755.,
               2150,  496.,
               2200,  249.,
               2250,   12.,
   FD(1)     = 5.991, 0.94,
!   HPNET        = 306.1,
   HPNET        = 314.1,       !2April98,NRMMII Data Sheets POWa 1/29/98, 8/30/98
   IB(1)        = 1, 1, 1,         !NRMMII Data Sheet's BW1a 8/30/98
   IDIESL(1)    = 1,               !NRMMII Data Sheet POWa 8/30/98
   IP(1)        = 1, 1, 1,         !NRMMII Data Sheet's BW1a 8/30/98
   ITVAR        = 0,               !NRMMII Data Sheets POWd 8/13/98
   KTROPR(1)    = 1, 1, 1, 1,
                  1, 1, 1, 1,
   LOCDIF       = 1,               !NRMMII Data Sheet POWa 8/30/98
   LOCKUP       = 1,               !NRMMII Data Sheet POWa 8/30/98
   NCYL(1)      = 6,               !NRMMII Data Sheet POWa 8/30/98
   NENG         = 1,
!   QMAX(1)      = 1320.2,
   QMAX(1)      = 1351.2,     !2April98,NRMMII Data Sheets POWa 1/29/98, 8/30/98
   REVM(1)      = 397, 397, 397,     !NRMMII Data Sheet BW1b 8/30/98,9/30/98
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   TCASE(1)      = 1.0, 1.0,
   TQIND         = 0,
!
!  Transmission - Allison 4070P
!
!   NGR           = 7,
!  TRANS         = 9.694, 0.78,
!                  4.461, 0.935,
!                  2.423, 0.937,
!                  1.896, 0.937,
!                  1.271, 0.94,
!                  0.9318, 0.925,
!                  0.8121, 0.906,
!
   NGR           = 7,
   TRANS         = 9.69, 0.959,  !2April98,NRMMII Data Sheet POWe 1/29/98,8/30/98
                   4.46, 0.969,
                   2.42, 0.971,
                   1.82, 0.973,
                   1.27, 0.980,
                   0.94, 0.972,
                   0.81, 0.970,
   NTRANG        = 1,            !NRMMII Data Sheet POWd 8/13/98
! IPOWER(1)=48                        !2April98,NRMMII Data Sheets POWf 1/29/98
! POWER     =    0.00, 23598,         !the reason for not using
!                2.00, 20313,         !doesn't have enough power
!                4.00, 17655,
!                6.00, 14522,
!                8.00, 11677,
!                8.91, 10487,
!                8.91,  8903,
!               10.00,  8399,
!               12.00,  7492,
!               14.00,  6655,
!               14.65,  6388,
!               14.65,  7365,
!               16.00,  6930,
!               18.00,  6073,
!               19.67,  5379,
!               19.67,  5477,
!               20.00,  5423,
!               22.00,  5012,
!               24.00,  4505,
!               26.00,  4065,
!               26.26,  3966,
!               26.26,  4009,
!               28.00,  3893,
!               30.00,  3715,
!               32.00,  3490,
!               34.00,  3238,
!               36.00,  2997,
!               37.52,  2824,
!               37.52,  2871,
!               38.00,  2851,
!               40.00,  2757,
!               42.00,  2645,
!               44.00,  2517,
!               46.00,  2379,
!               48.00,  2249,
!               50.00,  2123,
!               50.89,  2068,
!               50.89,  2090,
!               52.00,  2032,
!               54.00,  1928,
!               56.00,  1828,
!               58.00,  1731,
!               60.00,  1631,
!               62.00,  1525,
!               64.00,  1416,
!               65.00,  1348,
!               66.00,  1091,
!               66.45,   941,
!
! IPOWER(1)     = 43,                 !changed from 51 to 43, took out dupes
! POWER         = 0.00, 50497,        !2April98, This set of numbers were in the
!                 2.00, 36509,        !original file. We used this set because
!                 2.97, 29400,        !it has more power
!                 3.60, 25200,
!                 4.47, 19643,
!                 5.04, 16762,
!                 5.09, 15856,
```

```
!!                4.00, 17563,
!!                7.63, 12029,
!                7.63, 13605,
!                8.00, 13288,
!                10.00, 10646,
!                11.92, 7454,
!!                11.92, 7452,
!                12.00, 7417,
!!                14.06, 6548,
!                14.06, 7405,
!                16.00, 6823,
!                18.00, 5971,
!!                19.11, 5506,
!                19.11, 5506,
!                20.00, 5369,
!                22.00, 4973,
!                24.00, 4479,
!                26.36, 3931,
!!                26.36, 3931,
!                28.00, 3819,
!                30.00, 3646,
!                32.00, 3428,
!                34.00, 3180,
!                36.00, 2945,
!                37.21, 2807,
!!                37.21, 2807,
!                38.00, 2775,
!                40.00, 2683,
!                42.00, 2574,
!                44.00, 2449,
!!                46.60, 2272,
!                46.60, 2273,
!                48.00, 2214,
!                50.00, 2121,
!                52.00, 2020,
!                54.00, 1918,
!                56.00, 1821,
!                58.00, 1725,
!                60.00, 1626,
!                62.00, 1520,
!                64.00, 1412,
!                65.23, 1343,
!                66.00, 1090,
!                66.46, 941,
!  IPOWER(1)     = 52,          !3Sept98, NRMMII Data Sheets POWf 8/30/98
!  POWER         = 0.00 , 50910,
!                  2.00 , 36891,
!                  2.88 , 30300,
!                  3.52 , 25970,
!                  4.00 , 22984,
!                  4.09 , 22424,
!                  4.00 , 17655,
!                  6.00 , 14522,
!                  8.00 , 11677,
!                  8.91 , 10487,
!                  8.91 ,  8903,
!                 10.00 ,  8399,
!                 12.00 ,  7492,
!                 14.00 ,  6655,
!                 14.65 ,  6388,
!                 14.65 ,  7365,
!                 16.00 ,  6930,
!                 18.00 ,  6307,
!                 19.67 ,  5379,
!                 19.67 ,  5477,
!                 20.00 ,  5423,
!                 22.00 ,  5012,
!                 24.00 ,  4505,
!                 26.00 ,  4026,
!                 26.26 ,  3966,
!                 26.26 ,  4009,
!                 28.00 ,  3893,
!                 30.00 ,  3715,
!                 32.00 ,  3490,
!                 34.00 ,  3238,
!                 36.00 ,  2997,
!                 37.52 ,  2824,
!                 37.52 ,  2871,
!                 38.00 ,  2851,
!                 40.00 ,  2757,
!                 42.00 ,  2645,
```

```
!               44.00 ,  2517,
!               46.00 ,  2397,
!               48.00 ,  2249,
!               50.00 ,  2123,
!               50.89 ,  2068,
!               50.89 ,  2090,
!               52.00 ,  2032,
!               54.00 ,  1928,
!               56.00 ,  1803,
!               58.00 ,  1731,
!               60.00 ,  1631,
!               62.00 ,  1525,
!               64.00 ,  1416,
!               65.23 ,  1348,
!               66.00 ,  1091,
!               66.45 ,   941,
  IPOWER(1) = 52,
  POWER     =     0.00 , 51041,       !2Nov98, NRMMII Sheet POWf XLWB 8/30/98
                  2.00 , 36891,
                  2.66 , 31970,
                  3.31 , 27400,
                  4.00 , 22989,
                  4.09 , 22424,
                  4.00 , 17655,
                  6.00 , 14522,
                  8.00 , 11677,
                  8.91 , 10487,
                  8.91 ,  8903,
                 10.00 ,  8399,
                 12.00 ,  7492,
                 14.00 ,  6655,
                 14.65 ,  6388,
                 14.65 ,  7365,
                 16.00 ,  6930,
                 18.00 ,  6307,
                 19.67 ,  5379,
                 19.67 ,  5477,
                 20.00 ,  5423,
                 22.00 ,  5012,
                 24.00 ,  4505,
                 26.00 ,  4026,
                 26.26 ,  3966,
                 26.26 ,  4009,
                 28.00 ,  3893,
                 30.00 ,  3715,
                 32.00 ,  3490,
                 34.00 ,  3238,
                 36.00 ,  2997,
                 37.52 ,  2824,
                 37.52 ,  2871,
                 38.00 ,  2851,
                 40.00 ,  2757,
                 42.00 ,  2645,
                 44.00 ,  2517,
                 46.00 ,  2379,
                 48.00 ,  2249,
                 50.00 ,  2123,
                 50.89 ,  2068,
                 50.89 ,  2090,
                 52.00 ,  2032,
                 54.00 ,  1928,
                 56.00 ,  1828,
                 58.00 ,  1731,
                 60.00 ,  1631,
                 62.00 ,  1525,
                 64.00 ,  1416,
                 65.23 ,  1348,
                 66.00 ,  1091,
                 66.45 ,   941,
!  Highway characteristics
!
 ACD     = 1.0,    ! Flat plate estimate, NRMMII Data Sheet JHWY 8/30/98
 CD      = 1.2,    ! Flat plate estimate
 XBRCOF = 0.8,     ! Drum-brake shoe coefficient of friction
                   ! NRMMII Data Sheet BW1a 8/30/98
!
!  Ride quality characteristics
!
! below is original data provided with OTC proposal
   KOHIND(1) = 1, 1, 1, 1,
!   NHVALS     = 8,
```

```
!   HVALS(1)  = 0, 4.0, 6.0, 8.0,
!               10.0, 12.0, 14.0, 300.0,
!   VOOB(1,1) = 60.0, 60.0, 60.0, 60.0,
!               60.0, 60.0, 16.1, 10.7,
! below are values from SSEB vehdyn
!  NHVALS    = 8,
!   HVALS(1)  = 0, 4.0, 6.0, 8.0,
!               10.0, 12.0, 16.0, 300.0,
!   VOOB(1,1) = 99.9, 60.0, 60.0, 60.0,
!               50.0, 50.0, 11.38, 3.0,
!*********** !6April98, Numbers for vehicle requirements*************
!  HVALS(1)  =    0,  4.0,  6.0,   8.0,
!              10.0, 12.0, 16.0, 100.0,
!  VOOB(1,1) = 99.9, 60.0, 60.0, 60.0,
!              20.0,  8.0,  8.0, 8.0,
!****4Sept98, 2.5g Shock Performance, Field Test MTTRDYNAMICS 3-19-98***
!  NHVALS    =10,
!  HVALS(1)  =   0,   4.0,  6.0,  8.0,
!             10.0,  11.0, 12.0, 13.0,
!             16.0, 100.0,
!  VOOB(1,1)= 99.9,  60.0, 60.0, 60.0,
!             20.0,  17.0, 13.0, 10.0,
!             10.0,  10.0,
!***********24Sept98, NRMMII Data Sheets VOBS 8/30/98***********
!******I added a 100 at the end of HVALS, to make the model run*******
!   NHVALS    =10,
!   HVALS(1)  =     0,    4.0,  6.0,   8.0,  10.0,
!               12.0,  14.0, 16.0,  18.0, 100.0,
!  VOOB(1,1) = 55.0,  55.0, 55.0,  55.0,  55.0,
!              14.97, 11.20, 9.38,  6.02,   6.02,
!****9Nov98, Dan Creighton VEDYNII results for XLong Wheel Base *************
!****I added 100 to the end of HVALS to make model run *****
   NHVALS    =10,
   HVALS(1)  =    0.0  10.0  11.0  12.0  13.0
                14.0  15.0  16.0  20.0 100.0
   VOOB(1,1) =  60.0  60.0  15.0  11.5  11.0
                 9.5   6.0   4.0   4.0   4.0
! below is original data provided with OTC proposal
   KVRIND(1)     = 1, 1, 1, 1,
   ABSPWR(1)     = 6,  !6 watt ride level given NRMMII Data Sheet VRIDa 8/30/98
   MAXL          = 1,  !One ride tolerance level given,
                       !:NRMMII Data Sheet VRIDa 8/30/98
!
!   MAXIPR        = 13,
!   RMS(1)        = 0.0, 0.19, 0.34, 0.66,
!                   0.86, 1.01, 1.20, 1.81,
!                   2.17, 3.27, 3.49, 4.0, 5.0,
!   VRIDE(1,1,1) = 60.0, 60.0, 60.0, 60.0,
!                   48.2, 32.2, 27.8, 15.9,
!                   19.5, 10.8, 10.4, 9.6, 9.6,
! below are values from SSEB vehdyn
!   MAXIPR        = 14,
!   RMS(1)        = 0.0, 0.5, 0.6, 0.7,
!                   1.0, 1.3, 1.5, 1.8,
!                   2.0, 2.5, 3.0, 3.5, 4.0, 5.0,
!   VRIDE(1,1,1) = 99.9, 99.9, 99.9, 68.14,
!                   33.75, 23.12, 19.55, 16.29,
!                   14.87, 12.62, 11.32, 10.47, 9.87, 9.0,
!*********6April98, Numbers for vehicle requirements***********
!   RMS(1)        =  0.0,    0.5,    0.6,     0.7,
!                    1.0,    1.3,    1.5,     1.8,
!                    2.0,    2.5,    3.0,     3.5,
!                    4.0,    5.0,
!   VRIDE(1,1,1) = 99.9,  99.9,   99.9,  35.00,
!                   27.0, 23.12, 19.55,  16.29,
!                   14.87, 12.62, 11.32, 10.47,
!                    9.87,  9.0,
!**********15June98,6-Watt Ride Curve data from MTTRDYNAMICS_3-19-98.PPT********
!**********4Sept.98,6-Watt Ride Curve Field Test*************
!   MAXIPR        = 18,
!    RMS(1)        =  0.0,     0.25,     0.5,    0.75,
!                     1.0,     1.25,     1.5,    1.75,
!                     2.0,     2.25,     2.5,    2.75,
!                     3.0,     3.25,     3.5,    3.75,
!                     4.0,     6.00,
!    VRIDE(1,1,1) = 60.0,      60.0,  44.33,   31.29,
!                   24.44,     20.18, 17.25,   15.11,
!                   13.47,     12.18, 11.12,   10.25,
!                    9.51,      8.88,  8.33,    7.85,
!                    7.43,      6.00,
!**********22June98,per R.Jones 6-Watt Ride Curve data from RFP, 6-10-96,
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!**********3Sept98, per R.Jones 6-Watt Ride Curve data from RFP, 6-10-96,
!   MAXIPR        = 7,
!   RMS(1)        =   0.0,      0.7,      1.0,     1.5,    2.0,
!                     4.0,      6.0,
!   VRIDE(1,1,1) =  60.0,     35.0,    27.0,    20.0,   15.0,
!                    10.0,      8.0,
!*********8July98,VEDYNII, 6-Watt Ride Curve data from Greg Green*********
!   MAXIPR        =13,
!   RMS(1)        =   0.0,      0.5,      1.0,     1.5,    2.0,
!                    2.5,      3.0,      3.5,     4.0,    4.5,
!                     5.0,      5.5,      6.0,
!   VRIDE(1,1,1) =  80.0,     75.6,     38.1,    25.5,   19.2,
!                    15.4,     12.9,     11.1,     9.7,    8.6,
!                     7.8,      7.1,      6.5,
!*****10Sept98, OTC Data Set from NATC 9Sept98 per R.Jones**********
!  MAXIPR      =17,
!  RMS(1)      =    0.0, 0.75,  1.0,  1.25,  1.5,
!                 1.75,  2.0, 2.25,   2.5, 2.75,
!                  3.0, 3.25,  3.5,  3.75,  4.0,
!                 4.25,  4.5,
!  VRIDE(1,1,1) =70.5, 70.5, 53.4,  43.0, 36.0,
!                 31.0, 27.2, 24.3,  21.9, 20.0,
!                 18.4, 17.0, 15.8,  14.8, 13.9,
!                 13.1, 12.4,
!********24Sept98, NRMMII Data Sheets VRIDa 8/30/98*********
!***I added a 0 at the beginning, and a 6 at end of RMS; to make the model run*
!******I changed 104.5 in the VRIDE to 100, to make the model run *****
!   MAXIPR          =10,
!   RMS(1)          = 0,  0.5,   1.0,  1.5,  2.0,  2.5,
!                        3.0,   3.5,  4.0,  6,
!   VRIDE(1,1,1)  =104.5,    104.5, 53.4, 36.0, 27.2, 21.9,
!                    18.4,     15.8, 13.9,  6,
!   VRIDE(1,1,1)  =100.0,    100.0, 53.4, 36.0, 27.2, 21.9,
!                    18.4,     15.8, 13.9,  6,
!****9Nov98, Dan Creighton VEDYNII results for XLong Wheel Base ************
!***I added 6 at the end of RMS to make model run ******
   MAXIPR          = 10,
   RMS(1)          =   0.0  0.5  1.0   1.5   2.0
                       2.5  3.0  3.5   4.0   6.0
   VRIDE(1,1,1)   =  60.0 60.0 34.0  24.0  19.0
                     15.5 13.0 11.5  10.0  10.0
!  Swimming Characteristics
!
   DRAFT      = 0,
   FORDD      = 60,    !2Nov98 NRMMII Sheet WCR1 XLWB 8/30/98
   SAE        = 0,
   SAI        = 0,
   VFS        = 0,
   VSS        = 0,
   VSSAXP     = 0,
   WC         = 0,
   NWR        = 0,
   WDAXP      = 0,
   WDPTH(1)  = 0,
   WRAT(1)   = 0,
   WRFORD     = 0,
 $END              !1  OSHKOSH,XLWB W/Winch 2Nov98
NOHGT             !c:\jones-98\mttr-9\phase2\vehs\oshxlwb.obv
     3            !c:\vehicles\nrmmii\obw.dat
NANG              !c:\jones-98\mttr-9\phase2\vehs\oshxlwb.obo
     8
NWDTH
     3
```

CLRMIN INCHES	FOOMAX POUNDS	FOO POUNDS	HOVALS INCHES	AVALS RADIANS	WVALS INCHES
12.75	8766.4	236.8	3.15	1.95	5.88
0.20	26433.9	1423.0	15.75	1.95	5.88
-13.88	42871.3	3504.3	33.46	1.95	5.88
12.75	8766.4	239.3	3.15	2.48	5.88
2.34	24253.0	1216.4	15.75	2.48	5.88
-13.54	25472.2	2255.9	33.46	2.48	5.88
12.75	7798.3	258.5	3.15	2.69	5.88
4.14	17417.6	891.5	15.75	2.69	5.88
-13.38	17421.3	1926.3	33.46	2.69	5.88
12.75	4674.2	252.1	3.15	2.86	5.88
4.27	10683.0	809.2	15.75	2.86	5.88
-8.38	10547.5	1335.3	33.46	2.86	5.88
13.36	4689.6	265.8	3.15	3.42	5.88
6.73	9709.0	623.8	15.75	3.42	5.88
-10.89	10874.7	1153.4	33.46	3.42	5.88
14.15	5338.6	113.0	3.15	3.60	5.88

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   9.02    8210.4    823.8    15.75    3.60    5.88
  -3.96   17906.6   1335.6    33.46    3.60    5.88
  15.12    3497.8     14.8     3.15    3.80    5.88
  10.20   12705.7    992.2    15.75    3.80    5.88
  -2.11   11337.6    661.0    33.46    3.80    5.88
  15.90    2588.4     31.8     3.15    4.33    5.88
  14.19    3619.7    -63.0    15.75    4.33    5.88
  12.85   12309.3    708.0    33.46    4.33    5.88
  12.75    8199.8    241.0     3.15    1.95   29.88
   3.78   26433.9    922.5    15.75    1.95   29.88
 -13.30   42855.0   1363.2    33.46    1.95   29.88
  12.75    8199.8    245.8     3.15    2.48   29.88
   4.06   25490.3    640.0    15.75    2.48   29.88
 -13.26   25342.4   1768.8    33.46    2.48   29.88
  12.75    7798.3    237.8     3.15    2.69   29.88
   4.22   17438.1    857.0    15.75    2.69   29.88
 -13.38   17442.4   1912.2    33.46    2.69   29.88
  12.75    4661.0    196.4     3.15    2.86   29.88
   4.30   10629.1    757.7    15.75    2.86   29.88
  -5.41   10449.3   1217.2    33.46    2.86   29.88
  12.83    4696.9    235.6     3.15    3.42   29.88
   5.83   10791.5    743.9    15.75    3.42   29.88
 -15.07   10882.0   1166.8    33.46    3.42   29.88
  12.68    7901.9    244.7     3.15    3.60   29.88
   7.64    7655.5    656.2    15.75    3.60   29.88
 -12.58   17995.4   1481.5    33.46    3.60   29.88
  12.90    7887.8    201.5     3.15    3.80   29.88
   7.04   12725.0    838.4    15.75    3.80   29.88
  -4.72   26055.1   1272.0    33.46    3.80   29.88
  12.06   10523.2    648.1     3.15    4.33   29.88
   9.20   18861.7   1571.8    15.75    4.33   29.88
  -5.12   17436.0    716.5    33.46    4.33   29.88
  12.75    8347.7    182.5     3.15    1.95  141.60
   3.94   26310.0    820.4    15.75    1.95  141.60
  -9.49   31609.7   1245.7    33.46    1.95  141.60
  12.75    8347.7    185.1     3.15    2.48  141.60
   4.44   25480.5    649.4    15.75    2.48  141.60
  -7.83   22978.3   1330.9    33.46    2.48  141.60
  12.75    7789.7    181.3     3.15    2.69  141.60
   5.24   13831.7    504.9    15.75    2.69  141.60
  -9.11   16318.8   1254.8    33.46    2.69  141.60
  12.75    4654.2    143.6     3.15    2.86  141.60
   6.52    8550.3    493.3    15.75    2.86  141.60
   0.50    9620.8   1067.1    33.46    2.86  141.60
  12.71    4671.0    157.4     3.15    3.42  141.60
   0.83   10791.8    597.1    15.75    3.42  141.60
 -13.28   10885.3    993.2    33.46    3.42  141.60
  12.25    7818.2    183.5     3.15    3.60  141.60
   0.83   14760.0    767.7    15.75    3.60  141.60
 -23.98   17972.9   1338.5    33.46    3.60  141.60
  12.83    8310.0    144.8     3.15    3.80  141.60
   0.98   11875.5    594.9    15.75    3.80  141.60
 -25.05   26211.8   1386.7    33.46    3.80  141.60
  12.83    8650.6    174.2     3.15    4.33  141.60
   0.61   25697.6    779.0    15.75    4.33  141.60
 -25.09   37713.4   1691.6    33.46    4.33  141.60
 OSHKOSH,XLWB W/Winch(VEH1),2Nov98,27Oct98,23Oct98,24Sept.98,3April98
 $VEHICL
!2Nov98,   NRMMII Data Sheet's XLWB, 8/30/98
!          REFHT1, NRMMII Sheet HWVa XLWB 8/30/98
!          EFFRAD, NRMMII Sheet HWVb XLWB 8/30/98
!             ELL, NRMMII Sheet HWVb XLWB 8/30/98
!          EQUILF, NRMMII Sheet BW1a XLWB 8/30/98
!            CGZ1, NRMMII Sheet HWVa XLWB 8/30/98
!           XCLC1, NRMMII Sheet HWVb XLWB 8/30/98
!           YCLC1, NRMMII Sheet HWVb XLWB 8/30/98
!27Oct98, IFD's OTC-T-044, NRMMII Data Sheet HWVa,HWVb 9/21/98
!          EQUILF, Used loaded veh. wght.
!            CGZ1, Used loaded veh. wght.
!          EFFRAD, NRMMII Sheet HWVb, OTC-T-044, 9/21/98
!             ELL, NRMMII Sheet HWVb, OTC-T-044, 9/21/98
!           BALMU, NRMMII Sheet HWVb, OTC-T-044, 9/21/98
!           BALMD, NRMMII Sheet HWVb, OTC-T-044, 9/21/98
!           Missing DEE1,ZEE1,Bottom Profile
!*The OBSMOD model would not run with the data that was supplied**
!**Three suspension were used for this I/P. When you have a one unit vehicle
!**you are allowed only 2 suspension. We didn't use this I/P. We used the
!**Obsmod from the original file.
!23Oct98, I adjusted the necessary variables that were needed to make the
!OBSMOD file run.
!! RB.Ahlvin WES/MSD 24Nov93
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!! Comments: can't use comments before the $VEHICL line.
!!          : use only after the $VEHICL line
   NUNITS =   1,        !NRMMII Sheet HWVb 8/30/98 Number of units
!   NSUSP  =   3,       !NRMMII Sheet HWVb 8/30/98 Number of susp. supports
   NSUSP  =   2,        !23Oct98,24Sept98, From Drawing
   NVEH1  =   1,        ! Vehicle type; 0=tracked, 1=wheeled
   NFL    =    ,        ! Track type; 0=rigid, 1=flexible
!   REFHT1 =  35.4,     !2April98,NRMMII Data Sheet HWVa 1/29/98, 8/30/98
                        !Hght hitch from grd
   REFHT1 =    31, !2Nov98, NRMMII Sheet HWVa XLWB 8/30/98
   HTCHFZ =     0,      !2April98,NRMMII Sheet HWVa 1/29/98,V-force on hitch
!   SFLAG(1) =0,0,0,    !2April98,NRMMII Data Sheet HWVb 1/29/98, 8/30/98
                        !incorrect has 2 suspension
                        !Type susp @supt-i,0=indp,1=bogie
   SFLAG(1) =0,1,       !27Oct98, NRMMII HWVb, OTC-T-044, 9/21/98
                        !23Oct98,2April98, From Drawing 2/18/98, 8/30/98
                        !Type susp @supt-i,0=indp,1=bogie
!!  Power flags ((IP(i,j), i=1,nsusp) j=1,2)
!   IP(1,1)   = 1,1,1,0,0,  !NRMMII Data Sheet HWVb 8/30/98
!   IP(1,2)   = 0,0,0,0,0,
  IP(1,1)   = 1,1,0,0,0,  !23Oct98, 24Sept98 corrected
  IP(1,2)   = 0,1,0,0,0,
!  Brake flags ((IB(i,j), i=1,nsusp) j=1,2)
!   IB(1,1)   = 1,1,1,0,0,  !NRMMII Data Sheet HWVb 8/30/98
!   IB(1,2)   = 0,0,0,0,0,  !suspension 2 incorrect
   IB(1,1)   = 1,1,0,0,0,  !23Oct98, 24Sept98 corrected
   IB(1,2)   = 0,1,0,0,0,
!   EFFRAD(1)=23.33,23.28,23.31, !2April98,NRMMII Data Sheet HWVb 1/29/98,8/30/98
                                 !you are allowed 2 susp. support w/one unit
                                 !Eff loaded radius whls wrt grd
!   EFFRAD(1)= 26.45, 26.45,     !23Oct98, calculated
!   EFFRAD(1)= 23.21, 23.41,     !27Oct98, NRMMII Sheet HWVb1,OTC-T-044,9/21/98
    EFFRAD(1)= 23.16, 23.2,    !2Nov98 NRMMII Sheet HWVb1, 8/30/98
!   ELL(1)    =263.6,107.8,51.33, !2Apr98,NRMMII Data Sheet's HWVb1/29/98,8/30/98
!                                ! ELL(2) number given wrong
!   ELL(1)    =263.6,79.565,     !23Oct98,2April98,esti. From Drawing 2/18/98
!   ELL(1)    =265.1,81.05,      !27Oct98, NRMMII Data HWVb OTC-T-044 9/21/98
    ELL(1)    =337.11,121.11,   !2Nov98 NRMMII Sheet HWVb, 8/30/98
!   BWIDTH(1)= 0,0,0,            !2April98,NRMMII Data Sheet's HWVb 1/29/98,
                                 !suspension 2 missing
                                 !wheel to centerline wheel)
!   BWIDTH(1)= 0,56.5,           !23Oct98,2Apr98 # esti. from drawing 2/18/98,8/30/98
    BWIDTH(1)= 0,56.5,           !27Oct98, NRMMII Sheet HWVb 9/21/98
!                                !wheel to centerline wheel)
!   BALMU(1) = ,                 !2April98,NRMMII Data Sheet's HWVb 1/29/98,
                                 ! Missing number
!   BALMD(1) = ,                 !2April98,NRMMII Data Sheet's HWVb 1/29/98,
                                 ! Missing number
!   BALMU(1) = 0, 22,             !23Oct98,2April98, esti. from drawing 2/18/98
!   BALMD(1) = 0,-22,             !23Oct98,2April98, esti. from drawing 2/18/98
   BALMU(1) = 0,  11.6,      !27Oct98, NRMMII Data Sheet HWVb 09/21/98 OTC-T-044
   BALMD(1) = 0, -13.9,      !27Oct98, NRMMII Data Sheet HWVb 09/21/98 OTC-T-044
!   EQUILF(1)=12714,9638,7778,   !2April98,NRMMII Data Sheet HWVb 1/29/98,
                                 !susp. 2
!   EQUILF(1)=12714,17416,       !Added susp. 2&3 together
!   EQUILF(1)=10461,6271,4551,   !24Sept98, NRMMII Data Sheet HWVb 8/30/98
!   EQUILF(1)=10461,10822,       !Added susp. 2&3 together
!   EQUILF(1)=13014,30276,       !27Oct98 NRMMII Sheet BW1a 8/30/98
                                 !Used loaded vehicle wght., added axle2&3
    EQUILF(1)=13228,32436,   !2Nov98 Used loaded veh. wght. added Axle 2&3
!   CGZ1      = 43.5,            !2April98,NRMMII Sheet HWVa,1/29/98,8/30/98
!   CGZ1      = 55.5,             !27Oct98,NRMMII Sheet HWVa, OTC-T-044, 9/21/98
!                                !Used loaded CGH Wght. :V-cg, Unit-1 wrt grd
   CGZ1      =  55.8,        !2Nov98 Used loaded CGH Wght. NRMMII Sheet HWVa 8/30/98
   CGZ2      =    0,             !V-cg, Unit-2 wrt ground
   DEE1      =  0                !27Oct98, MISSING H-cg, Unit-1 payload wrt hitch
   ZEE1      =  0                !27Oct98, MISSING V-cg, Unit-1 payload wrt grd
   DEE2      =  0                !H-cg, Unit-2 payload wrt hitch
   ZEE2      =  0                !V-cg, Unit-2 payload wrt ground
!   DELTW1    = 14200,            !2April98 NRMMII Sheet HWVa 1/29/98,8/30/98
                        !:Didn't use payload because didn't supply the CG location
   DELTW1    =  0,      !27Oct98 Didn't use payload because didn't supply CG location
   DELTW2    =  0,      !2April98 NRMMII Data Sheet HWVa 1/29/98
!  NPTSC1    = 28,               !2April98 NRMMII Data Sheet HPRF 1/29/98
!                                ! #Pts, bottom profile, Unit-1
!****2April98, NRMMII Data Sheet HPRF 1/29/98**********
!****Special Note 15 is the max number for XCLC1, YCLC1,*******
!    This bottom profile looks low
!  XCLC1(1) =310.2, 307.5, 296.8, 293.7, 293.7,
!             281.8, 281.8, 278.2, 251.1, 251.1,
!             138.9, 138.9, 126.1, 126.1, 122.5,
```

```
!               95.3,  95.3,  69.6,  69.6,  66.0,
!               38.8,  38.8,  21.9,  19.8,  15.8,
!               15.8,   3.3,   0.0,
!  YCLC1(1) = 35.25, 34.5,  34.0,  34.0,  30.2,
!               30.2,  18.9,  15.3,  15.3,  19.6,
!               19.6,  26.2,  26.2,  18.9,  15.3,
!               15.3,  24.9,  23.3,  18.9,  15.3,
!               15.3,  31.7,  31.7,  23.4,  23.4,
!               32.4,  32.4,  32.8,
!****2April98, NRMMII Data Sheet HPRF 1/29/98**********
!****Omitted some of the numbers for the bottom profile XCLC1 & YCLC1
!    NPTSC1   = 10,
!   XCLC1(1)=310.2, 293.7, 281.8, 266.7,    243, !from drawing 3April98 Unit-1
!            138.9, 111.0,  54.3,  19.8,      0, !gave us too many numbers
!   YCLC1(1)= 35.25, 30.9,  18.9,  15.3,  19.6, !from drawing 3April98 Unit-1
!             19.6,  15.3,  15.3,  23.4,   32.8,!bottom profile look's LOW
!***24Sept98, NRMMII Data Sheet HPRF 8/30/98************
!****Special Note 15 is the max number for XCLC1, YCLC1,*******
!****** when you have a one unit vehicle******
!   NPTSC1    = 26,
!   XCLC1(1) = 309.4, 304.7, 283.4, 283.4,   279.7,
!              252.6, 252.6, 140.4, 140.4,   127.6,
!              127.6, 124.0,  96.8,  96.8,    71.1,
!               71.1,  67.5,  40.3,  40.3,    24.4,
!               24.4,  20.4,  20.4,  11.0,    11.0,
!                  0,
!   YCLC1(1) =  36.8,  30.6,  30.6,  19.6,    15.9,
!               15.9,  20.5,  20.3,  26.7,    26.7,
!               19.5,  15.9,  15.9,  25.5,    23.9,
!               19.5,  15.9,  15.9,  32.3,    32.3,
!               23.9,  23.9,  32.3,  32.3,    29.2,
!               29.2,
!****23Oct98, NRMMII Data Sheet HPRF 1/29/98**********
!****Omitted some of the numbers for the bottom profile XCLC1 & YCLC1
!   NPTSC1    = 15,
!   XCLC1(1) = 309.4, 304.7, 283.4, 279.7, 252.6,
!              252.6, 140.4, 127.6, 124.0,  96.8,
!               40.3,  24.4,  20.4,  11.0,     0,
!   YCLC1(1) =  36.8,  30.6,  30.6,  15.9,  15.9,
!               20.5,  20.3,  19.5,  15.9,  15.9,
!              15.9,  23.9,  23.9,  29.2,  29.2,
!***2Nov98, NRMMII Sheet HPRF 8/30/98*********
!***Omitted some of the numbers for the bottom profile XCLC1 & YCLC1
   NPTSC1    = 15,
   XCLC1(1) =381.3,  376.3, 355.3, 351.7, 324.6,
             324.6,  167.6, 163.9,  80.3,  80.3,
              20.4,  20.4,   11.0,  11.0,   0.0,
   YCLC1(1) = 36.8,   30.6,  30.6,  15.9,  15.9,
              20.5,   19.5,  15.9,  15.9,  23.7
              23.7,   32.2,  32.2,  29.1,  29.1,
   NPTSC2    =,              ! #Pts, bottom profile, Unit-2
   XCLC2(1) =,
   YCLC2(1) =,
   SFLAG(4) = 0,           ! Type suspension front "spridler" (always zero)
   IP(4,1)  =,             ! Power flag, front "spridler"
   IB(4,1)  =,             ! Brake flag, front "spridler"
   ELL(4)   =,             ! H-pos front "spridler" wrt hitch
   ZS(4)    =,             ! V-pos centerline front "spridler" wrt ground
   EFFRAD(4)=,             ! Effective radius front "spridler" measure from
!                           ! centerline to outher edge of track
   SFLAG(5) = 0,           ! Type suspension rear "spridler" (always zero)
   IP(5,1)  =,             ! Power flag, rear "spridler"
   IB(5,1)  =,             ! Brake flag, rear "spridler"
   ELL(5)   =,             ! H-pos rear "spridler" wrt hitch
   ZS(5)    =,             ! V-pos centerline rear "spridler" wrt ground
   EFFRAD(5)=,             ! Effective radius rear "spridler" measure from
                           ! centerline to outher edge of track
 $END
OSHXLWB
!<Include 60-character vehicle title as first line of data>
!
! CAMMS/NRMM-II Linear-feature vehicle data                 Form: 4 Aug 91
! This is the format and content for the vehicle data required to run the
! linear-feature (gap-crossing) prediction model in the CAMMS/NRMM-II
! system.  The format is FORTRAN Namelist input format.  The specific
! syntax is as documented in the VAX/VMS fortran and is similiar for
! most FORTRAN compilers that implement namelist input.  The actual input
! is handled by an emulator which is coded in standard fortran-77.  An
! extension to the standard syntax is to ignore the "!" and all text
! information following the "!" for the remainder of the input line.
! This file can be used as the skeleton for the actual input data file
```

```
! and should read O-K as is.
!      This data should be placed at end of normal NRMM-II vehicle file
! (after the obstacle performance matrix data) to create the complete CAMMS/
! NRMM-II data set.
! <The comment lines from here to just after the vehicle title may be deleted>
!
! Vehicle description:OSHKOSH XLWB(extra long wheel base)
! Changes: 3Apr02 changed the vlen from 386.5" to 415" for SWIMCRIT
!
!
! Date entered:04/01/02  Entered by:_____________ Checked by:_____________
!
! Updates:_____________________________________________________________
!
 $LFVDAT
! Over-all description:
   IVTYPE=      1 , ! 1=wheeled, 2=flex-track, 3=gird-track
   IVCONF=      2 , ! if wheeled; 1=4x4, 2=6x6, 3=8x8
                    ! if tracked; 1=Normal, 2=Dozer, 4=Comb. 1&2
   GVW    =  45664, ! BW1a gross vehicle weight {lbs}
   VVCI1 =    30.7, ! Vehicle 1-pass VCI for fine-grained soils {RCI}
! Geometry:Vegetation
!    VLEN  = 386.5, ! HWVa 8/30/98,Over-all length {in}
   VLEN   =    415, ! 3Apr02, For Swimcrit extended leng from 386.5 to 415"
                    ! Over-all leng in.
   VWIDTH =   97.4, ! HWVa 8/30/98,Over-all width {in}
   VAADEG =     20, ! Esti. from picture Approach/departure angle {deg}
   VCLR   =     29, ! Esti. from picture Frame end clrance ("clrance line"){in}
   VRR    =     23, ! Esti. Roadwheel radius (+track-thickness if tracked){in}
   VTL    =244.25, ! HWVa Front-rear grd whl center-line distance {in}
   VCGF   =  153.6, ! drawing, Horizontal-distance C-G to frt-whl ctr-ln{in}
   VCGH   =     29, ! Esti. Verticle-distance C-G to frt-whl center-line{in}
! Wheeled vehicle additional geometry data
   WHLGWS =187.75, ! drawing, Distance between wheels of greatest span {in}
   WBCLR  =  16.73, ! BW1a, Clrance between whls of greatest span{in}
! Tracked vehicle additional data
   TRKLEN =       , ! Length of track on ground (one-side) {in}
   TRKWID =       , ! Width of one track (one-side) {in}
   TRKD   =       , ! Hull depth above end clearance line {in}
   KTPAD  =       , ! Track pad code 1=HAS-pads; 0=NO-pads
! Tracked vehicle sprocket/idler configuration for non-dozer (i.e. IVCONF=1,4)
   RR1    =       , ! Sproket/idler radius {in}
   RR2    =       , ! Horizontal-dist. road-wheel ctr. to sproket/idler ctr. {in}
   RR3    =       , ! Verticle-dist. road-wheel ctr. to sproket/idler ctr. {in}
! Swimming/fording characteristics
   VSWIM  =      0, ! Vehicle swim speed (0.=NON-SWIMMER) {mph}
   VFORD  =       , ! Vehicle fording speed (pre-set to 5mph)
   DFLOAT =     60, ! WCR1, 8/30/98, Vehicle maximum fording debth {in}
 $ END
```

MTVR XLWB with Trailer Vehicle File

```
OSHKOSHXLWB w/M1095, (truck 7.1Ton payload W/Winch)
***************************************************************************
**** 17April02, This file is for the USMC HIMARS project for Randy Jones****
**** the JMTK(SWIMCRIT)information is for the truck ONLY.          ********
**** Does NOT include the JMTK(SWIMCRIT)data for the trailer data   ********
***************************************************************************
Project:Randy Jones,17Apr02 USMC HIMARS
Added the M1095 Trailer on the 17Apr02
!Dates: 2Nov98,29Oct98,27Oct98,23Oct98,13Oct98,1Oct98,28Sep98,25Sep98,10Sep98
!       3Sep98,8Jul98,22Jun98,15Jun98
!VEH1, 2April98
Changed: 1May02, PBF to loaded weight truck only
Modified,  2Nov98: from NRMMII Data Sheet's XLWB, 8/30/98
                   Converted to an extra long wheel base
                   WGHT, NRMMII Sheet BW1a,xlwb,8/30/98
                  AXLSP, NRMMII Sheet BW1a,xlwb,8/30/98
                    CGH, NRMMII Sheet HW1a,xlwb,8/30/98
                    CGR, Calculated 2Nov98
                    PBF, NRMMII Sheet JHWY 8/30/98
                     CL, NRMMII Sheet HW1a,xlwb,8/30/98
                   PBHT, NRMMII Sheet HWVa,xlwb,8/30/98
                     TL, NRMMII Sheet HWVa,xlwb,8/30/98
                  VULEN, NRMMII Sheet HW1a,xlwb,8/30/98
                  DFLCT, NRMMII Sheet BW1c,xlwb,8/30/98
                  CONV2, NRMMII Sheet POWb,xlwb,8/30/98
                 ENGINE, NRMMII Sheet POWc,xlwb,8/30/98
                  POWER, NRMMII Sheet POWf,xlwb,8/30/98
                  FORDD, NRMMII Sheet WCR1,xlwb,8/30/98
                 REFHT1, NRMMII Sheet HWVa,xlwb,8/30/98
                 EFFRAD, NRMMII Sheet HWVb,xlwb,8/30/98
                    ELL, NRMMII Sheet HWVb,xlwb,8/30/98
                 EQUILF, NRMMII Sheet BW1a,xlwb,8/30/98
                   CGZ1, NRMMII Sheet HWVa,xlwb,8/30/98
                  XCLC1, NRMMII Sheet HPRF,xlwb,8/30/98
                  YCLC1, NRMMII Sheet HPRF,xlwb,8/30/98
Modified, 2Nov98: Dan Creighton 9Nov98, VEDYNII results, for XLong Wheel Base
                  HVALS
                  VOOB
                  RMS
                  VRIDE
Modified, 27Oct98, from IFD's OTC-T-044, 9/21/98
                   CGZ1, Used CGH,loaded Wght.,because missing variables
                   DEE1,ZEE1, Missing
                   SFLAG, NRMMII Sheet HWVb, OTC-T-044, 9/21/98
                   EFFRAD,NRMMII Sheet HWVb, OTC-T-044, 9/21/98
                   ELL, NRMMII Sheet HWVb, OTC-T-044, 9/21/98
                   BALMD, Changed to negative
                   EQUILF, Used loaded Wght.,because missing variales
Modified, 23Oct98, Created a new Obsmod file, Data from
                   Drawing,calculated,Est.
                   NRMMII Data Sheet HWVa,HWVb 8/30/98 information MISSING
Modified, 13Oct98, RDIAM, NRMMII Data Sheet BW1a 9/30/98
                   CGH,CGR,DEFL CC, MTVR PHASEII-184-56.5-CAT 9/30/98
Modified, 10Sept98, HROSUS
Modified, 3Sept98, from NRMMII Data Sheet's 8/30/98
Modified, 8July98 6-Watt Ride Curve, Data from VEDYNII Model
Modified, 22June98 6-Watt Ride Curve,Data from(RFP 6-10-96,per R.Jones
          :22June98
Modified, 15June98 6-Watt Ride Curve,Data from (MTTRDYNAMICS_3-19-98.PPT)
          :MTTR Program(Performance Testing)TARDEC
          :The only change was the 6-Watt Ride Curve
Project:Randy Jones, 2April98
OBSMOD:23April02 I ran the oshxlwb as one unit than ran the m1095 trl as
       another unit added WVALS INCHES 300
! File Name: c:\jones-98\mttr-4\nrmm259b\vehs\veh1.dat     !2April98
! File Name: c:\jones-98\mttr-4\nrmm259b\vehs\OSHKOSH.DAT !22June98
                                                          !6-Watt Ride Curve change
                                                          !********************
                                                          !15June98
                                                          !The only change was
                                                          !the 6-Watt Ride Curve
! File Name:c:\jones-98\mttr-7\vehs\oshkosh.dat!8July98 VEHDYN2 6-Watt Ride Curve
! File Name:c:\jones-98\mttr-9\PHASE2\vehs\oshkosh.dat!ModNRMMII Data Sheet8/30/98
!                                                        !10Sept98 Mod HROSUS 9Sept98
! File Name:c:\jones-98\mttr-9\PHASE2\vehs\oshhrosu.dat !10Sept98 used original
                                                        !HROSUS=-16.7
! File Name:c:\jones-98\mttr-9\PHASE2\vehs\osh257.dat !6Oct.98, to run NRMM257
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! File Name:c:\jones-98\mttr-9\PHASE2\vehs\oshxlwb.dat !2Nov98 w/exlong whl base
  File Name:c:\jones-02\usmc-himars\vehicles\oshxlwb.trl !17April02
 OSHKOSHXLWB w/M1095 (truck 7.1Ton payload W/Winch)
 $VEHICLE
!
!  General Characteristics
!
   NAMBLY    = 5,
!   WGHT(1)   = 12311, 13706, 13706,
!   WGHT(1)   = 12472, 16002, 15846,      !OTC FEB98,NRMMII Sheet BW1a 1/29/98
!   WGHT(1)   = 13014, 15160, 15116,      !3Sept98, NRMMII Sheet BW1a 8/30/98
!   WGHT(1)   = 13228, 16131, 16305,  !2Nov98, NRMMII Sheets BW1a XLWB, 8/30/98
   WGHT(1)   =13228,16131,16305,9550,9550,!2Nov98,truck NRMMII Sheets BW1a
                                          !XLWB,8/30/98
                                       !18Apr02(7Mar00,trl data from Joe Rouse)
   NVUNTS    = 2,
   NSUSP     = 5,
!   RAID(1)   = 780., 1121., 1121.,
   RAID(1)  =662.4,1053.4,1053.4,700,700,!2April98,NRMMII Data Sheet BW1g1/29/98
                                         !18Apr02, trl esti.
!   HROSUS(1) = 16.1, 16.1, 16.1,      !value is positive because of a roll bar
!   HROSUS(1) = -16.7, -16.7, -16.7,   !2April98, NRMMII Data Sheets BW1a 1/29/98
   HROSUS(1) =11.4,11.4,11.4,2*11.4,   !10Sept98, from NATC 9/4/98
                                       !:NRMMII Sheet BW1a XLWB 8/30/98
                                       !18Apr02, trl esti.
   VSLIMX    = 0.0,
   VTIPMX    = 0.0,
!
!  Vehicle Geometry
!
! AXLSP(1)  = 156.3, 56.0,
! AXLSP(1)  = 155.75, 56.50,           !OTC FEB98
                                       !:NRMMII Data Sheet's BW1a 8/30/98
 AXLSP(1)  =187.75,56.50,228.9,56,     !2Nov98 OTC-T-053,XLWB 10/29/98
                                       !18Apr02, trl esti. from picture
! CGH       = 55.9,
! CGH       = 55.41,                 !changed to agree with Vehdyn/DADS #'s
! CGH       = 55.8,                  !2April98,NRMMII Sheet HWVa 1/29/98,8/30/98
! CGH       = 55.5,                  !13Oct98, MTVR PHASEII-184-56.5-CAT,9/30/98
 CGH       = 55.8,             !2Nov98 NRMMII Sheet HWVa XLWB 8/30/98
 CGLAT     = 0,                      !NRMMII Data Sheet HWVa 8/30/98
! CGR       = 83.1,
! CGR       = 83.8,                    !changed to agree with Vehdyn/DADS #'s
! CGR       = 83.3,                     !13Oct98 MTVR PHASEII-184-56.5-CAT,9/30/98
 CGR       = 90.7,             !2Nov98, calculated, prime mover only
! CL        = 17.,
! CLRMIN(1) = 17., 17., 17.,
! CL        = 16.2,                     !used value from technical proposal
! CL        = 20.8,                     !2April98,NRMMII Data Sheets HWVa 1/29/98
 CL        = 20.3,             !2Nov98 NRMMII Sheet HWVa XLWB 8/30/98
! CLRMIN(1) = 16.2, 16.2, 16.2,         !used value from technical proposal
 CLRMIN(1) =16.45,16.73,16.83,2*14.5,   !2April98,NRMMII Data Sheets BW1a 1/29/98
                                        !18Apr02(7Mar00,trl data from Joe Rouse)
! EYEHGT    = 100.4,
 EYEHGT    = 105.5,                     !OTC FEB98 NRMMII Data Sheet HWVa 8/30/98
! PBF       = 40750,
! PBF       = 44320,                    !OTC FEB98
! PBF       = 40750,                    !2April98,NRMMII Data Sheets JHWY 1/29/98
! PBF       = 43290,                    !3Sept98,NRMMII Data Sheets A 8/30/98
! PBF       = 40750,                    !25Sept98,NRMMII Sheet JHWY XLWB 8/30/98
!  PBF       = 31064,                 !2Nov98 Curb wt.,NRMMII Sheet JHWY,8/30/98
  PBF       = 45664,                !1May02, changed to loaded weight,truck only
! PBHT      = 48.,
! PBHT      = 36.4,                     !OTC FEB98,NRMMII Data Sheet HWVa 8/30/98
 PBHT      = 36.8,                  !2Nov98 NRMMII Sheet HWVa XLWB 8/30/98
 PFA       = 69.0,                      !NRMMII Data Sheet JHWY 8/30/98
! TL        = 212.25,                   !NRMMII Data Sheet HWVa 8/30/98
! TL         = 244.25,              !2Nov98 NRMMII Sheet HWVa 8/30/98
 TL        = 529,                   !2Nov98 NRMMII Sheet HWVa 8/30/98
                                  !18Apr02, trl esti. from picture
 WDTH      = 97.4,                      !NRMMII Data Sheet HWVa 8/30/98
! VULEN(1)  = 311.3,
! VULEN(1)  = 319.6,                    !OTC FEB98, NRMMII Data Sheet HWVa 8/30/98
 VULEN(1)  = 386.5,230.6,               !2Nov98 NRMMII Sheet HWVa 8/30/98
                                        !18Apr02, trl data from Stewart&Stevenson
!
!  Tire characteristics, Tire data supplied by Michelin
!
!   AVGC       = 681,
   AVGC       =  800,                 !2Apil98,NRMMII Sheet JHWY 1/29/98,8/30/98
!   DFLCT(1,1) = 2.46, 2.46, 2.46,
```

```
!   DFLCT(1,2) = 3.13, 3.13, 3.13,
!   DFLCT(1,3) = 4.61, 4.61, 4.61,
!   DFLCT(1,4) = 5.39, 5.39, 5.39,
!***Special Note Vendor indicated total wght of each axle, for each dflct,***
!*** NRMMII Data Sheets BW1d, 2April98 ********************
!   DFLCT(1,1) = 2.23, 2.24, 2.22, !2April98,HWY  NRMMII Data Sheets BW1c 1/29/98
!   DFLCT(1,2) = 3.12, 3.17, 3.14, !2April98,CC   NRMMII Data Sheets BW1c 1/29/98
!   DFLCT(1,3) = 4.30, 4.62, 4.62, !2April98,MSS  NRMMII Data Sheets BW1c 1/29/98
!   DFLCT(1,4) = 4.60, 5.21, 5.24, !2April98,EM'C NRMMII Data Sheets BW1c 1/29/98
!   DFLCT(1,1) = 2.36, 2.13, 2.13, !3Sept98,HWY  NRMMII Data Sheets BW1c 8/30/98
!   DFLCT(1,2) = 3.24, 3.04, 3.03, !3Sept98,CC   NRMMII Data Sheets BW1c 8/30/98
!   DFLCT(1,2) = 3.24, 3.02, 3.01, !13Oct98,CC MTVR PHASEII-184-56.5-CAT,9/30/98
!   DFLCT(1,3) = 4.47, 4.42, 4.41, !3Sept98,MSS  NRMMII Data Sheets BW1c 8/30/98
!   DFLCT(1,3) = 4.47, 4.54, 4.52, !25Sept98,MSS  NRMMII Data Sheets BW1c 8/30/98
!   DFLCT(1,4) = 4.78, 5.00, 4.99, !3Sept98,EM'C NRMMII Data Sheets BW1c 8/30/98
   DFLCT(1,1)  =2.23,2.26,2.28,2.23,2.26,!2Nov98 NRMMII Sheet BW1c,XLWB 8/30/98
                                   !18Apr02,trl used axl1,axl2 from truck defl
   DFLCT(1,2)  =3.29,3.21,3.24,3.29,3.21,!2Nov98 NRMMII Sheet BW1c,XLWB 8/30/98
                                   !18Apr02,trl used axl1,axl2 from truck defl
   DFLCT(1,3)  =4.54,4.80,4.84,4.54,4.80,!2Nov98 NRMMII Sheet BW1c,XLWB 8/30/98
                                   !18Apr02,trl used axl1,axl2 from truck defl
   DFLCT(1,4)  =4.85,5.29,5.33,4.85,5.29,!2Nov98 NRMMII Sheet BW1c,XLWB 8/30/98
                                   !18Apr02,trl used axl1,axl2 from truck defl
   DIAW(1)    =52.9,52.9,52.9,2*46.9, !NRMMII Data Sheet's BW1b 8/30/98,9/30/98
                                    !18Apr02(7Mar00,trl data from Joe Rouse)
   ICONST(1)  = 3*0, 2*0,              !NRMMII Data Sheet's BW1b 8/30/98,9/30/98
   ID(1)      = 0, 0, 0,2*0,           !NRMMII Data Sheet's BW1a 8/30/98
   IT(1)      = 0, 0, 0,1,1,           !NRMMII Data Sheet's BW1a 8/30/98
! changed CTIS scenario so all contractor use same
   KCTIOP(1)  = 0, 0, 0, 0,            !CTIS tire operating scenario
                0, 0, 0, 0,            !0=compute internally
!   KCTIOP(1)  = 1, 1, 3, 2,
!                2, 3, 2, 3,
   KTSFLG(1)  = 1, 1, 1,2*1,         !NRMMII Data Sheet's BW1b 8/30/98
!   JVPSI      = 6,                   !2April98,NRMMII Data Sheets BW1f 1/29/98
   JVPSI      = 2,                   !I changed JVPSI from 6 to 2,
                                     !because we don't have JVPSI=6
                                     !I set JVPSI=2 for Cross Country DFLCT
   NCHAIN(1)  = 0, 0, 0, 2*0,        !NRMMII Data Sheet's BW1a 8/30/98
   NJPSI      = 4,
   NVEH(1)    = 1, 1, 1, 2*1,
   NWHL(1)    = 2, 2, 2, 2*2,         !NRMMII Data Sheet's BW1a 8/30/98
!  RDIAM(1)   = 22., 22., 22.,        !NRMMII Data Sheet's BW1b 8/30/98
   RDIAM(1)   = 20., 20., 20.,2*20,   !9Oct98, NRMMII Sheet BW1b 9/30/98,9/30/98
   RW(1)      = 23.3, 23.3, 23.3,2*23.45,
   RIMW(1)    = 10.0, 10.0, 10.0,2*10,   !NRMMII Sheet BW1b 8/30/98,9/30/98
                                      !18Apr02(7Mar00,trl data from Joe Rouse)
   SECTH(1)   =13.4,13.4,13.4,2*10.4,  !NRMMII Data Sheet BW1b 8/30/98,9/30/98
                                      !18Apr02(7Mar00,trl data from Joe Rouse)
   SECTW(1)   =17.2,17.2,17.2,2*15.4,  !NRMMII Data Sheet BW1b 8/30/98,9/30/98
                                      !18Apr02(7Mar00,trl data from Joe Rouse)
   TIREID     ='Michelin 425/95 R20 XZL', !NRMMII Data Sheet BW1b 8/30/98,9/30/98
   TPLY(1)    = 22., 22., 22.,2*14,    !NRMMII Data Sheet BW1b 8/30/98
                                      !18Apr02(7Mar00,trl data from Joe Rouse)
!   TPSI(1,1)  =43., 46., 46.,
!   TPSI(1,1)  =41., 53., 53.         !changed per OTC IFD-T-65
!   TPSI(1,2)  =27., 31., 31.,
!   TPSI(1,2)  =26., 38., 38.,           !changed per OTC IFD-T-65
!   TPSI(1,3)  = 14., 16., 16.,
!   TPSI(1,3)  = 14., 18., 18.,          !changed per OTC IFD-T-65
!   TPSI(1,4)  = 11., 12., 12.,
   TPSI(1,1)=41.,57.,57.,41,57,!2April98 NRMMII Data Sheets BW1e1/29/98 8/30/98
                               !18Apr02,trl used axl1,axl2 from truck
   TPSI(1,2)=26.,35.,35.,26,35,!2April98 NRMMII Data Sheets BW1e1/29/98 8/30/98
                               !18Apr02,trl used axl1,axl2 from truck
!   TPSI(1,3)  = 14., 20., 20.,   !2April98,mss NRMMII Data Sheets BW1e 1/29/98
   TPSI(1,3)  =14.,19.,19.,14,19,!25Sept98 NRMMII Data Sheets BW1e 8/30/98
                                 !18Apr02,trl used axl1,axl2 from truck
   TPSI(1,4)=11.,15.,15.,11,15,!2April98 NRMMII Data Sheets BW1e1/29/98 8/30/98
                                 !18Apr02,trl used axl1,axl2 from truck
!   VTIRMX(1)  = 55, 40, 20, 9, !NRMMII Data Sheet's BW1f 8/30/98
!   VTIRMX(1) = 75, 40, 20, 9, !1Oct.98 changed 55 to 75 for the TRAVERSE Model
                               !per R.Jones
   VTIRMX(1)  = 60, 40, 12, 5, !23Apr02 R.Jones USMC-HIMARS Project
   WT(1)     =80.75,80.75,80.75,2*80.5,  !NRMMII Sheet BW1a, XLWB 8/30/98
                                       !18Apr02(7Mar00,trl data from Joe Rouse)
   WTE(1)    =61.25,61.25,61.25,2*64,   !NRMMII Sheet BW1a, XLWB 8/30/98
!                                      !18Apr02(7Mar00,trl data from Joe Rouse)
!  Powertrain characteristics
!
 CID(1) = 729,                !Caterpillar C 12, NRMMII Sheet POWa 8/30/98
```

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!
 ICONV1      = 22,
! CONV1(1,1) = 1565, 0,
!              1594, 0.1,
!              1613, 0.2,
!              1647, 0.3,
!              1675, 0.4,
!              1700, 0.472,
!              1711, 0.5,
!              1752, 0.595,
!              1754, 0.6,
!              1791, 0.7,
!              1819, 0.75,
!              1845, 0.8,
!              1878, 0.85,
!              1930, 0.89,
!              1983, 0.9,
!              2041, 0.9115,
!              2100, 0.9224,
!              2102, 0.9237,
!              2104, 0.9250,
!              2129, 0.94,
!              2146, 0.95,
!              2170, 0.96,
! ICONV2      = 22,
! CONV2(1,1) = 1.864, 0,
!              1.758, 0.1,
!              1.673, 0.2,
!              1.603, 0.3,
!              1.525, 0.4,
!              1.456, 0.4715,
!              1.425, 0.5,
!              1.315, 0.5954,
!              1.310, 0.6,
!              1.195, 0.7,
!              1.134, 0.75,
!              1.076, 0.8,
!              1.013, 0.85,
!              0.9766, 0.89,
!              0.9674, 0.9,
!              0.9643, 0.9115,
!              0.9634, 0.9224,
!              0.9616, 0.9237,
!              0.9598, 0.9250,
!              0.9515, 0.94,
!              0.9453, 0.95,
!              0.9272, 0.96,
!
 ICONV1      =22,                !2April98,NRMMII Data Sheets POWb 1/29/98,8/30/98
 CONV1(1,1) = 1575, 0.00,
              1603, 0.10,
              1622, 0.20,
              1656, 0.30,
              1685, 0.40,
              1709, 0.47,
              1720, 0.50,
              1761, 0.60,
              1764, 0.60,
              1801, 0.70,
              1829, 0.75,
              1855, 0.80,
              1889, 0.85,
              1940, 0.89,
              1993, 0.90,
              2046, 0.91,
              2100, 0.92,
              2103, 0.92,
              2106, 0.93,
              2131, 0.94,
              2148, 0.95,
              2172, 0.96,
! ICONV2= 18,                         !2April98, NRMMII Data Sheets POWb 1/29/98
! CONV2(1,1)= 1.897, 0.00 ,
!              1.790, 0.10 ,
!              1.704, 0.20 ,
!              1.644, 0.30 ,
!              1.553, 0.40 ,
!              1.462, 0.50 ,
!              1.341, 0.60 ,
!              1.221, 0.70 ,
!              1.157, 0.75 ,
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!               1.105, 0.80 ,
!               1.048, 0.85 ,
!               1.00 , 0.89 ,
!               1.00 , 0.89 ,
!               1.00 , 0.90 ,
!               1.00 , 0.925,
!               1.00 , 0.94 ,
!               1.00 , 0.95 ,
!               1.00 , 0.96 ,
! ICONV2= 18,                              !3Sept98, NRMMII Data Sheets POWb 8/30/98
! CONV2(1,1)=    1.85 , 0.00 ,
!                1.75 , 0.10 ,
!                1.66 , 0.20 ,
!                1.59 , 0.30 ,
!                1.51 , 0.40 ,
!                1.41 , 0.50 ,
!                1.31 , 0.60 ,
!                1.19 , 0.70 ,
!                1.13 , 0.75 ,
!                1.07 , 0.80 ,
!                1.01 , 0.85 ,
!                0.95 , 0.89 ,
!                0.95 , 0.89 ,
!                0.96 , 0.90 ,
!                0.96 , 0.925,
!                0.94 , 0.94 ,
!                0.94 , 0.95 ,
!                0.92 , 0.96 ,
  ICONV2= 22,                              !2Nov98, NRMMII Sheet POWb XLWB 8/30/98
  CONV2(1,1)=    1.85 , 0.00 ,
                 1.75 , 0.10 ,
                 1.66 , 0.20 ,
                 1.59 , 0.30 ,
                 1.51 , 0.40 ,
                 1.45 , 0.47 ,
                 1.42 , 0.50 ,
                 1.31 , 0.595,
                 1.30 , 0.60 ,
                 1.19 , 0.70 ,
                 1.13 , 0.75 ,
                 1.07 , 0.80 ,
                 1.01 , 0.85 ,
                 0.95 , 0.89 ,
                 0.96 , 0.90 ,
                 0.96 , 0.91 ,
                 0.96 , 0.92 ,
                 0.96 , 0.92 ,
                 0.96 , 0.93 ,
                 0.94 , 0.94 ,
                 0.94 , 0.95 ,
                 0.92 , 0.96 ,
  ! IENGIN      = 9,
!
! ENGINE(1,1) = 1200, 1320.,
!               1300, 1300.,
!               1400, 1261.,
!               1500, 1208.,
!               1600, 1142.,
!               1700, 1064.,
!               1900, 921.,
!               2100, 765.,
!               2300, -183., !*this looks weird, can leave in talked to R.Ahlvin
!
! ENGINE(1,1) = 1200, 1351.,          !2April98, NRMMII Data Sheets POWc 1/29/98
!               1300, 1330.,          !Torque
!               1400, 1291.,
!               1500, 1237.,
!               1600, 1169.,
!               1700, 1090.,
!               1900, 944.,
!               2100, 785.,
!               2300, -183., !*this looks weird, can leave in talked to R. Ahlvin
! IENGIN      = 10,
! ENGINE(1,1) = 1060, 1356.,          !3Sept98, NRMMII Data Sheets POWc 8/30/98
!               1200, 1325.,
!               1300, 1303.,
!               1400, 1264.,
!               1500, 1209.,
!               1600, 1141.,
!               1700, 1062.,
!               1900,  915.,
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!               2100,  755.,
!               2150,  496.,
 IENGIN     = 12,
 ENGINE(1,1) = 1060, 1356.,          !2Nov98, NRMMII Sheets POWc XLWB 8/30/98
              1200, 1325.,
              1300, 1303.,
              1400, 1264.,
              1500, 1209.,
              1600, 1141.,
              1700, 1062.,
              1900,  915.,
              2100,  755.,
              2150,  496.,
              2200,  249.,
              2250,   12.,
   FD(1)     = 5.991, 0.94,
!   HPNET        = 306.1,
   HPNET        = 314.1,      !2April98,NRMMII Data Sheets POWa 1/29/98, 8/30/98
   IB(1)        = 1, 1, 1,1,1,   !NRMMII Data Sheet's BW1a 8/30/98
   IDIESL(1)    = 1,             !NRMMII Data Sheet POWa 8/30/98
   IP(1)        = 1, 1, 1,0,0,   !NRMMII Data Sheet's BW1a 8/30/98
   ITVAR        = 0,             !NRMMII Data Sheets POWd 8/13/98
   KTROPR(1)    = 1, 1, 1, 1,
                  1, 1, 1, 1,
   LOCDIF       = 1,             !NRMMII Data Sheet POWa 8/30/98
   LOCKUP       = 1,             !NRMMII Data Sheet POWa 8/30/98
   NCYL(1)      = 6,             !NRMMII Data Sheet POWa 8/30/98
   NENG         = 1,
!   QMAX(1)      = 1320.2,
   QMAX(1)      = 1351.2,     !2April98,NRMMII Data Sheets POWa 1/29/98, 8/30/98
   REVM(1)      =397,397,397,447,447,!NRMMII Data Sheet BW1b 8/30/98,9/30/98
                                     !18Apr02, trl calculated
   TCASE(1)     = 1.0, 1.0,
   TQIND        = 0,
!
!  Transmission - Allison 4070P
!
!   NGR          = 7,
!  TRANS        = 9.694, 0.78,
!                 4.461, 0.935,
!                 2.423, 0.937,
!                 1.896, 0.937,
!                 1.271, 0.94,
!                 0.9318, 0.925,
!                 0.8121, 0.906,
!
   NGR          = 7,
   TRANS        = 9.69, 0.959,   !2April98,NRMMII Data Sheet POWe 1/29/98,8/30/98
                  4.46, 0.969,
                  2.42, 0.971,
                  1.82, 0.973,
                  1.27, 0.980,
                  0.94, 0.972,
                  0.81, 0.970,
   NTRANG       = 1,             !NRMMII Data Sheet POWd 8/13/98
! IPOWER(1)=48                       !2April98,NRMMII Data Sheets POWf 1/29/98
! POWER    =    0.00, 23598,         !the reason for not using
!               2.00, 20313,         !doesn't have enough power
!               4.00, 17655,
!               6.00, 14522,
!               8.00, 11677,
!               8.91, 10487,
!               8.91,  8903,
!              10.00,  8399,
!              12.00,  7492,
!              14.00,  6655,
!              14.65,  6388,
!              14.65,  7365,
!              16.00,  6930,
!              18.00,  6073,
!              19.67,  5379,
!              19.67,  5477,
!              20.00,  5423,
!              22.00,  5012,
!              24.00,  4505,
!              26.00,  4065,
!              26.26,  3966,
!              26.26,  4009,
!              28.00,  3893,
!              30.00,  3715,
!              32.00,  3490,
```

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!              34.00,  3238,
!              36.00,  2997,
!              37.52,  2824,
!              37.52,  2871,
!              38.00,  2851,
!              40.00,  2757,
!              42.00,  2645,
!              44.00,  2517,
!              46.00,  2379,
!              48.00,  2249,
!              50.00,  2123,
!              50.89,  2068,
!              50.89,  2090,
!              52.00,  2032,
!              54.00,  1928,
!              56.00,  1828,
!              58.00,  1731,
!              60.00,  1631,
!              62.00,  1525,
!              64.00,  1416,
!              65.00,  1348,
!              66.00,  1091,
!              66.45,   941,
!
! IPOWER(1)    = 43,                    !changed from 51 to 43, took out dupes
! POWER        = 0.00, 50497,           !2April98, This set of numbers were in the
!                2.00, 36509,           !original file. We used this set because
!                2.97, 29400,           !it has more power
!                3.60, 25200,
!                4.47, 19643,
!                5.04, 16762,
!                5.09, 15856,
!!                4.00, 17563,
!!                7.63, 12029,
!                7.63, 13605,
!                8.00, 13288,
!                10.00, 10646,
!                11.92, 7454,
!!                11.92, 7452,
!                12.00, 7417,
!!                14.06, 6548,
!                14.06, 7405,
!                16.00, 6823,
!                18.00, 5971,
!!                19.11, 5506,
!                19.11, 5506,
!                20.00, 5369,
!                22.00, 4973,
!                24.00, 4479,
!                26.36, 3931,
!!                26.36, 3931,
!                28.00, 3819,
!                30.00, 3646,
!                32.00, 3428,
!                34.00, 3180,
!                36.00, 2945,
!                37.21, 2807,
!!                37.21, 2807,
!                38.00, 2775,
!                40.00, 2683,
!                42.00, 2574,
!                44.00, 2449,
!!                46.60, 2272,
!                46.60, 2273,
!                48.00, 2214,
!                50.00, 2121,
!                52.00, 2020,
!                54.00, 1918,
!                56.00, 1821,
!                58.00, 1725,
!                60.00, 1626,
!                62.00, 1520,
!                64.00, 1412,
!                65.23, 1343,
!                66.00, 1090,
!                66.46, 941,
! IPOWER(1)    = 52,          !3Sept98, NRMMII Data Sheets POWf 8/30/98
! POWER        = 0.00 , 50910,
!                2.00 , 36891,
!                2.88 , 30300,
!                3.52 , 25970,
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!                 4.00 , 22984,
!                 4.09 , 22424,
!                 4.00 , 17655,
!                 6.00 , 14522,
!                 8.00 , 11677,
!                 8.91 , 10487,
!                 8.91 ,  8903,
!                10.00 ,  8399,
!                12.00 ,  7492,
!                14.00 ,  6655,
!                14.65 ,  6388,
!                14.65 ,  7365,
!                16.00 ,  6930,
!                18.00 ,  6307,
!                19.67 ,  5379,
!                19.67 ,  5477,
!                20.00 ,  5423,
!                22.00 ,  5012,
!                24.00 ,  4505,
!                26.00 ,  4026,
!                26.26 ,  3966,
!                26.26 ,  4009,
!                28.00 ,  3893,
!                30.00 ,  3715,
!                32.00 ,  3490,
!                34.00 ,  3238,
!                36.00 ,  2997,
!                37.52 ,  2824,
!                37.52 ,  2871,
!                38.00 ,  2851,
!                40.00 ,  2757,
!                42.00 ,  2645,
!                44.00 ,  2517,
!                46.00 ,  2397,
!                48.00 ,  2249,
!                50.00 ,  2123,
!                50.89 ,  2068,
!                50.89 ,  2090,
!                52.00 ,  2032,
!                54.00 ,  1928,
!                56.00 ,  1803,
!                58.00 ,  1731,
!                60.00 ,  1631,
!                62.00 ,  1525,
!                64.00 ,  1416,
!                65.23 ,  1348,
!                66.00 ,  1091,
!                66.45 ,   941,
  IPOWER(1) = 52,
  POWER     =     0.00 , 51041,        !2Nov98, NRMMII Sheet POWf XLWB 8/30/98
                  2.00 , 36891,
                  2.66 , 31970,
                  3.31 , 27400,
                  4.00 , 22989,
                  4.09 , 22424,
                  4.00 , 17655,
                  6.00 , 14522,
                  8.00 , 11677,
                  8.91 , 10487,
                  8.91 ,  8903,
                 10.00 ,  8399,
                 12.00 ,  7492,
                 14.00 ,  6655,
                 14.65 ,  6388,
                 14.65 ,  7365,
                 16.00 ,  6930,
                 18.00 ,  6307,
                 19.67 ,  5379,
                 19.67 ,  5477,
                 20.00 ,  5423,
                 22.00 ,  5012,
                 24.00 ,  4505,
                 26.00 ,  4026,
                 26.26 ,  3966,
                 26.26 ,  4009,
                 28.00 ,  3893,
                 30.00 ,  3715,
                 32.00 ,  3490,
                 34.00 ,  3238,
                 36.00 ,  2997,
                 37.52 ,  2824,
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                    37.52 ,  2871,
                    38.00 ,  2851,
                    40.00 ,  2757,
                    42.00 ,  2645,
                    44.00 ,  2517,
                    46.00 ,  2379,
                    48.00 ,  2249,
                    50.00 ,  2123,
                    50.89 ,  2068,
                    50.89 ,  2090,
                    52.00 ,  2032,
                    54.00 ,  1928,
                    56.00 ,  1828,
                    58.00 ,  1731,
                    60.00 ,  1631,
                    62.00 ,  1525,
                    64.00 ,  1416,
                    65.23 ,  1348,
                    66.00 ,  1091,
                    66.45 ,   941,
!  Highway characteristics
!
 ACD    = 1.0,    ! Flat plate estimate, NRMMII Data Sheet JHWY 8/30/98
 CD     = 1.2,    ! Flat plate estimate
 XBRCOF = 0.8,    ! Drum-brake shoe coefficient of friction
                  ! NRMMII Data Sheet BW1a 8/30/98
!
!  Ride quality characteristics
!
! below is original data provided with OTC proposal
   KOHIND(1) = 1, 1, 1, 1,
!   NHVALS    = 8,
!   HVALS(1)  = 0, 4.0, 6.0, 8.0,
!               10.0, 12.0, 14.0, 300.0,
!   VOOB(1,1) = 60.0, 60.0, 60.0, 60.0,
!               60.0, 60.0, 16.1, 10.7,
! below are values from SSEB vehdyn
!  NHVALS    = 8,
!   HVALS(1)  = 0, 4.0, 6.0, 8.0,
!               10.0, 12.0, 16.0, 300.0,
!   VOOB(1,1) = 99.9, 60.0, 60.0, 60.0,
!               50.0, 50.0, 11.38, 3.0,
!*********** !6April98, Numbers for vehicle requirements**************
!  HVALS(1)  =    0,  4.0,  6.0,   8.0,
!              10.0, 12.0, 16.0, 100.0,
!  VOOB(1,1) = 99.9, 60.0, 60.0, 60.0,
!              20.0,  8.0,  8.0, 8.0,
!****4Sept98, 2.5g Shock Performance, Field Test MTTRDYNAMICS 3-19-98***
!  NHVALS    =10,
!  HVALS(1)  =   0,   4.0,  6.0,  8.0,
!             10.0,  11.0, 12.0, 13.0,
!             16.0, 100.0,
!  VOOB(1,1)= 99.9,  60.0, 60.0, 60.0,
!             20.0,  17.0, 13.0, 10.0,
!             10.0,  10.0,
!***********24Sept98, NRMMII Data Sheets VOBS 8/30/98***********
!******I added a 100 at the end of HVALS, to make the model run*******
!   NHVALS    =10,
!   HVALS(1)  =    0,   4.0,  6.0,   8.0,  10.0,
!               12.0,  14.0, 16.0,  18.0, 100.0,
!  VOOB(1,1) = 55.0,  55.0, 55.0,  55.0,  55.0,
!              14.97, 11.20, 9.38,  6.02,   6.02,
!****9Nov98, Dan Creighton VEDYNII results for XLong Wheel Base *************
!****I added 100 to the end of HVALS to make model run *****
   NHVALS    =10,
   HVALS(1)  =   0.0  10.0  11.0  12.0  13.0
                14.0  15.0  16.0  20.0 100.0
   VOOB(1,1) =  60.0  60.0  15.0  11.5  11.0
                 9.5   6.0   4.0   4.0   4.0
! below is original data provided with OTC proposal
   KVRIND(1)     = 1, 1, 1, 1,
   ABSPWR(1)     = 6,  !6 watt ride level given NRMMII Data Sheet VRIDa 8/30/98
   MAXL          = 1,  !One ride tolerance level given,
                       !:NRMMII Data Sheet VRIDa 8/30/98
!
!   MAXIPR        = 13,
!   RMS(1)        = 0.0, 0.19, 0.34, 0.66,
!                   0.86, 1.01, 1.20, 1.81,
!                   2.17, 3.27, 3.49, 4.0, 5.0,
!   VRIDE(1,1,1) = 60.0, 60.0, 60.0, 60.0,
!                   48.2, 32.2, 27.8, 15.9,
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!                  19.5, 10.8, 10.4, 9.6, 9.6,
! below are values from SSEB vehdyn
!   MAXIPR        = 14,
!   RMS(1)        = 0.0, 0.5, 0.6, 0.7,
!                   1.0, 1.3, 1.5, 1.8,
!                   2.0, 2.5, 3.0, 3.5, 4.0, 5.0,
!   VRIDE(1,1,1) = 99.9, 99.9, 99.9, 68.14,
!                   33.75, 23.12, 19.55, 16.29,
!                   14.87, 12.62, 11.32, 10.47, 9.87, 9.0,
!*********6April98, Numbers for vehicle requirements***********
!   RMS(1)        =  0.0,    0.5,    0.6,     0.7,
!                    1.0,    1.3,    1.5,     1.8,
!                    2.0,    2.5,    3.0,     3.5,
!                    4.0,    5.0,
!   VRIDE(1,1,1) = 99.9,   99.9,   99.9,   35.00,
!                   27.0, 23.12, 19.55,  16.29,
!                   14.87, 12.62, 11.32, 10.47,
!                    9.87,   9.0,
!**********15June98,6-Watt Ride Curve data from MTTRDYNAMICS_3-19-98.PPT********
!**********4Sept.98,6-Watt Ride Curve Field Test*************
!   MAXIPR        = 18,
!    RMS(1)        =  0.0,     0.25,    0.5,    0.75,
!                     1.0,     1.25,    1.5,    1.75,
!                     2.0,     2.25,    2.5,    2.75,
!                     3.0,     3.25,    3.5,    3.75,
!                     4.0,     6.00,
!    VRIDE(1,1,1) = 60.0,     60.0,  44.33,   31.29,
!                   24.44,    20.18, 17.25,  15.11,
!                   13.47,    12.18, 11.12,  10.25,
!                    9.51,     8.88,  8.33,    7.85,
!                    7.43,     6.00,
!**********22June98,per R.Jones 6-Watt Ride Curve data from RFP, 6-10-96,
!**********3Sept98, per R.Jones 6-Watt Ride Curve data from RFP, 6-10-96,
!   MAXIPR        = 7,
!   RMS(1)        =   0.0,      0.7,     1.0,     1.5,    2.0,
!                     4.0,      6.0,
!   VRIDE(1,1,1) =  60.0,     35.0,    27.0,    20.0,   15.0,
!                   10.0,      8.0,
!*********8July98,VEDYNII, 6-Watt Ride Curve data from Greg Green*********
!   MAXIPR        =13,
!   RMS(1)        =   0.0,      0.5,     1.0,     1.5,    2.0,
!                   2.5,      3.0,     3.5,     4.0,    4.5,
!                     5.0,      5.5,     6.0,
!   VRIDE(1,1,1) =  80.0,     75.6,    38.1,    25.5,   19.2,
!                   15.4,     12.9,    11.1,     9.7,    8.6,
!                     7.8,      7.1,     6.5,
!*****10Sept98, OTC Data Set from NATC 9Sept98 per R.Jones**********
!  MAXIPR      =17,
!  RMS(1)      =    0.0, 0.75,  1.0,  1.25,  1.5,
!                 1.75,  2.0, 2.25,   2.5, 2.75,
!                   3.0, 3.25,  3.5,  3.75,  4.0,
!                 4.25,  4.5,
!  VRIDE(1,1,1) =70.5, 70.5, 53.4,  43.0, 36.0,
!                 31.0, 27.2, 24.3,  21.9, 20.0,
!                 18.4, 17.0, 15.8,  14.8, 13.9,
!                 13.1, 12.4,
!********24Sept98, NRMMII Data Sheets VRIDa 8/30/98*********
!***I added a 0 at the beginning, and a 6 at end of RMS; to make the model run*
!******I changed 104.5 in the VRIDE to 100, to make the model run *****
!   MAXIPR          =10,
!   RMS(1)          = 0,  0.5,   1.0,  1.5,  2.0,  2.5,
!                         3.0,   3.5,  4.0,  6,
!   VRIDE(1,1,1)  =104.5,    104.5, 53.4, 36.0, 27.2, 21.9,
!                    18.4,     15.8, 13.9,  6,
!   VRIDE(1,1,1)  =100.0,    100.0, 53.4, 36.0, 27.2, 21.9,
!                    18.4,     15.8, 13.9,  6,
!****9Nov98, Dan Creighton VEDYNII results for XLong Wheel Base ************
!***I added 6 at the end of RMS to make model run ******
   MAXIPR          = 10,
   RMS(1)          =    0.0  0.5  1.0   1.5   2.0
                        2.5  3.0  3.5   4.0   6.0
   VRIDE(1,1,1)    =   60.0 60.0 34.0  24.0  19.0
                       15.5 13.0 11.5  10.0  10.0
!  Swimming Characteristics
!
   DRAFT     = 0,
   FORDD     = 60,    !2Nov98 NRMMII Sheet WCR1 XLWB 8/30/98
   SAE       = 0,
   SAI       = 0,
   VFS       = 0,
   VSS       = 0,
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   VSSAXP    = 0,
   WC        = 0,
   NWR       = 0,
   WDAXP     = 0,
   WDPTH(1)  = 0,
   WRAT(1)   = 0,
   WRFORD    = 0,
 $END
NOHGT       !23Apr02 1 OSHKOSH,XLWB W/m1095 trl
     3      !c:\vehicles\nrmmii\obsmod\oshxlwb.obv
NANG        !c:\vehicles\nrmmii\obsmod\m1095trl.obv
     8      !c:\vehicles\nrmmii\obsmod\obwxlwb.dat
NWDTH       !c:\vehicles\nrmmii\obsmod\obmdcomb osxlw300.obo m1095trl.obo ;
     4      !  > osxlwm10.cmb
 CLRMIN    FOOMAX    FOO       HOVALS    AVALS     WVALS
 INCHES    POUNDS    POUNDS    INCHES    RADIANS   INCHES
  12.75    8766.4     236.8      3.15      1.95      5.88
   0.20   26433.9    1423.0     15.75      1.95      5.88
 -13.88   42871.3    3504.3     33.46      1.95      5.88
  12.75    8766.4     239.3      3.15      2.48      5.88
   2.34   24253.0    1216.4     15.75      2.48      5.88
 -13.54   25472.2    2255.9     33.46      2.48      5.88
  12.75    7798.3     258.5      3.15      2.69      5.88
   4.14   17417.6     891.5     15.75      2.69      5.88
 -13.38   17421.3    1926.3     33.46      2.69      5.88
  12.75    4674.2     252.1      3.15      2.86      5.88
   4.27   10683.0     809.2     15.75      2.86      5.88
  -8.38   10547.5    1335.3     33.46      2.86      5.88
  13.36    4689.6     265.8      3.15      3.42      5.88
   6.73    9709.0     623.8     15.75      3.42      5.88
 -10.89   10874.7    1153.4     33.46      3.42      5.88
  14.15    5338.6     113.0      3.15      3.60      5.88
   9.02    8210.4     823.8     15.75      3.60      5.88
  -3.96   17906.6    1335.6     33.46      3.60      5.88
  15.12    3497.8      14.8      3.15      3.80      5.88
  10.20   12705.7     992.2     15.75      3.80      5.88
  -2.11   11337.6     661.0     33.46      3.80      5.88
  15.90    2588.4      31.8      3.15      4.33      5.88
  14.19    3619.7     -63.0     15.75      4.33      5.88
  12.85   12309.3     708.0     33.46      4.33      5.88
  12.75    8199.8     241.0      3.15      1.95     29.88
   3.78   26433.9     922.5     15.75      1.95     29.88
 -13.30   42855.0    1363.2     33.46      1.95     29.88
  12.75    8199.8     245.8      3.15      2.48     29.88
   4.06   25490.3     640.0     15.75      2.48     29.88
 -13.26   25342.4    1768.8     33.46      2.48     29.88
  12.75    7798.3     237.8      3.15      2.69     29.88
   4.22   17438.1     857.0     15.75      2.69     29.88
 -13.38   17442.4    1912.2     33.46      2.69     29.88
  12.75    4661.0     196.4      3.15      2.86     29.88
   4.30   10629.1     757.7     15.75      2.86     29.88
  -5.41   10449.3    1217.2     33.46      2.86     29.88
  12.83    4696.9     235.6      3.15      3.42     29.88
   5.83   10791.5     743.9     15.75      3.42     29.88
 -15.07   10882.0    1166.8     33.46      3.42     29.88
  12.68    7901.9     244.7      3.15      3.60     29.88
   7.64    7655.5     656.2     15.75      3.60     29.88
 -12.58   17995.4    1481.5     33.46      3.60     29.88
  12.90    7887.8     201.5      3.15      3.80     29.88
   7.04   12725.0     838.4     15.75      3.80     29.88
  -4.72   26055.1    1272.0     33.46      3.80     29.88
  12.06   10523.2     648.1      3.15      4.33     29.88
   9.20   18861.7    1571.8     15.75      4.33     29.88
  -5.12   17436.0     716.5     33.46      4.33     29.88
  12.75    8347.7     182.5      3.15      1.95    141.60
   3.94   26310.0     820.4     15.75      1.95    141.60
  -9.49   31609.7    1245.7     33.46      1.95    141.60
  12.75    8347.7     185.1      3.15      2.48    141.60
   4.44   25480.5     649.4     15.75      2.48    141.60
  -7.83   22978.3    1330.9     33.46      2.48    141.60
  12.75    7789.7     181.3      3.15      2.69    141.60
   5.24   13831.7     504.9     15.75      2.69    141.60
  -9.11   16318.8    1254.8     33.46      2.69    141.60
  12.75    4654.2     143.6      3.15      2.86    141.60
   6.52    8550.3     493.3     15.75      2.86    141.60
   0.50    9620.8    1067.1     33.46      2.86    141.60
  12.71    4671.0     157.4      3.15      3.42    141.60
   0.83   10791.8     597.1     15.75      3.42    141.60
 -13.28   10885.3     993.2     33.46      3.42    141.60
  12.25    7818.2     183.5      3.15      3.60    141.60
   0.83   14760.0     767.7     15.75      3.60    141.60
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 -23.98   17972.9    1338.5     33.46     3.60    141.60
  12.83    8310.0     144.8      3.15     3.80    141.60
   0.98   11875.5     594.9     15.75     3.80    141.60
 -25.05   26211.8    1386.7     33.46     3.80    141.60
  12.83    8650.6     174.2      3.15     4.33    141.60
   0.61   25697.6     779.0     15.75     4.33    141.60
 -25.09   37713.4    1691.6     33.46     4.33    141.60
  12.75    7987.2      98.2      3.15     1.95    300.00
   6.32   26020.4     556.6     15.75     1.95    300.00
  -7.46   39144.6    1159.2     33.46     1.95    300.00
  12.75    7987.2      99.2      3.15     2.48    300.00
   6.84   12039.2     599.0     15.75     2.48    300.00
  -6.57   26215.6    1176.5     33.46     2.48    300.00
  12.75    7810.2     117.1      3.15     2.69    300.00
   7.38   15868.2     539.9     15.75     2.69    300.00
  -9.13   17967.9    1109.4     33.46     2.69    300.00
  12.75    4660.6      98.2      3.15     2.86    300.00
   8.03   10791.5     540.4     15.75     2.86    300.00
   0.33   10875.6    1007.9     33.46     2.86    300.00
  13.11    4662.5     114.0      3.15     3.42    300.00
   8.01   10794.6     549.3     15.75     3.42    300.00
   0.36   10874.7    1025.6     33.46     3.42    300.00
  12.81    7813.7     122.9      3.15     3.60    300.00
   7.58   12702.0     660.2     15.75     3.60    300.00
  -9.20   17966.3    1153.5     33.46     3.60    300.00
  13.18    8264.8     132.1      3.15     3.80    300.00
   5.16   11917.0     465.4     15.75     3.80    300.00
  -9.76   26209.3    1291.1     33.46     3.80    300.00
  13.06    8720.4     155.8      3.15     4.33    300.00
   0.39   25881.1     611.0     15.75     4.33    300.00
 -23.65   31843.6    1194.0     33.46     4.33    300.00
 OSHKOSH,XLWB W/Winch(VEH1),2Nov98,27Oct98,23Oct98,24Sept.98,3April98
 $VEHICL
!23Apr02 used the combined obsmod program and ran this veh. plus M1095trl
!2Nov98,  NRMMII Data Sheet's XLWB, 8/30/98
!         REFHT1, NRMMII Sheet HWVa XLWB 8/30/98
!         EFFRAD, NRMMII Sheet HWVb XLWB 8/30/98
!            ELL, NRMMII Sheet HWVb XLWB 8/30/98
!         EQUILF, NRMMII Sheet BW1a XLWB 8/30/98
!           CGZ1, NRMMII Sheet HWVa XLWB 8/30/98
!          XCLC1, NRMMII Sheet HWVb XLWB 8/30/98
!          YCLC1, NRMMII Sheet HWVb XLWB 8/30/98
!27Oct98, IFD's OTC-T-044, NRMMII Data Sheet HWVa,HWVb 9/21/98
!         EQUILF, Used loaded veh. wght.
!           CGZ1, Used loaded veh. wght.
!         EFFRAD, NRMMII Sheet HWVb, OTC-T-044, 9/21/98
!            ELL, NRMMII Sheet HWVb, OTC-T-044, 9/21/98
!          BALMU, NRMMII Sheet HWVb, OTC-T-044, 9/21/98
!          BALMD, NRMMII Sheet HWVb, OTC-T-044, 9/21/98
!          Missing DEE1,ZEE1,Bottom Profile
!*The OBSMOD model would not run with the data that was supplied**
!**Three suspension were used for this I/P. When you have a one unit vehicle
!**you are allowed only 2 suspension. We didn't use this I/P. We used the
!**Obsmod from the original file.
!23Oct98, I adjusted the necessary variables that were needed to make the
!OBSMOD file run.
!! RB.Ahlvin WES/MSD 24Nov93
!! Comments: can't use comments before the $VEHICL line.
!!          : use only after the $VEHICL line
   NUNITS =   1,        !NRMMII Sheet HWVb 8/30/98 Number of units
!   NSUSP  =   3,       !NRMMII Sheet HWVb 8/30/98 Number of susp. supports
   NSUSP  =  2,         !23Oct98,24Sept98, From Drawing
   NVEH1  =  1,         ! Vehicle type; 0=tracked, 1=wheeled
   NFL    =   ,         ! Track type; 0=rigid, 1=flexible
!   REFHT1 =  35.4,     !2April98,NRMMII Data Sheet HWVa 1/29/98, 8/30/98
                        !Hght hitch from grd
   REFHT1 =   31, !2Nov98, NRMMII Sheet HWVa XLWB 8/30/98
   HTCHFZ =      0,     !2April98,NRMMII Sheet HWVa 1/29/98,V-force on hitch
!   SFLAG(1) =0,0,0,    !2April98,NRMMII Data Sheet HWVb 1/29/98, 8/30/98
                        !incorrect has 2 suspension
                        !Type susp @supt-i,0=indp,1=bogie
   SFLAG(1) =0,1,       !27Oct98, NRMMII HWVb, OTC-T-044, 9/21/98
                        !23Oct98,2April98, From Drawing 2/18/98, 8/30/98
                        !Type susp @supt-i,0=indp,1=bogie
!!  Power flags ((IP(i,j), i=1,nsusp) j=1,2)
!   IP(1,1)  = 1,1,1,0,0,  !NRMMII Data Sheet HWVb 8/30/98
!   IP(1,2)  = 0,0,0,0,0,
  IP(1,1)  = 1,1,0,0,0,  !23Oct98, 24Sept98 corrected
  IP(1,2)  = 0,1,0,0,0,
! Brake flags ((IB(i,j), i=1,nsusp) j=1,2)
!   IB(1,1)  = 1,1,1,0,0,  !NRMMII Data Sheet HWVb 8/30/98
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!   IB(1,2)  = 0,0,0,0,0,  !suspension 2 incorrect
   IB(1,1)  = 1,1,0,0,0,  !23Oct98, 24Sept98 corrected
   IB(1,2)  = 0,1,0,0,0,
!   EFFRAD(1)=23.33,23.28,23.31, !2April98,NRMMII Data Sheet HWVb 1/29/98,8/30/98
                                 !you are allowed 2 susp. support w/one unit
                                 !Eff loaded radius whls wrt grd
!   EFFRAD(1)= 26.45, 26.45,     !23Oct98, calculated
!   EFFRAD(1)= 23.21, 23.41,     !27Oct98, NRMMII Sheet HWVb1,OTC-T-044,9/21/98
    EFFRAD(1)= 23.16, 23.2,    !2Nov98 NRMMII Sheet HWVb1, 8/30/98
!   ELL(1)    =263.6,107.8,51.33, !2Apr98,NRMMII Data Sheet's HWVb1/29/98,8/30/98
!                                 ! ELL(2) number given wrong
!   ELL(1)    =263.6,79.565,     !23Oct98,2April98,esti. From Drawing 2/18/98
!   ELL(1)    =265.1,81.05,      !27Oct98, NRMMII Data HWVb OTC-T-044 9/21/98
    ELL(1)    =337.11,121.11,   !2Nov98 NRMMII Sheet HWVb, 8/30/98
!   BWIDTH(1)= 0,0,0,            !2April98,NRMMII Data Sheet's HWVb 1/29/98,
                                 !suspension 2 missing
                                 !wheel to centerline wheel)
!   BWIDTH(1)= 0,56.5,           !23Oct98,2Apr98 # esti. from drawing 2/18/98,8/30/98
    BWIDTH(1)= 0,56.5,           !27Oct98, NRMMII Sheet HWVb 9/21/98
!                                !wheel to centerline wheel)
!   BALMU(1) = ,                 !2April98,NRMMII Data Sheet's HWVb 1/29/98,
                                 ! Missing number
!   BALMD(1) = ,                 !2April98,NRMMII Data Sheet's HWVb 1/29/98,
                                 ! Missing number
!   BALMU(1)`= 0, 22,             !23Oct98,2April98, esti. from drawing 2/18/98
!   BALMD(1) = 0,-22,             !23Oct98,2April98, esti. from drawing 2/18/98
   BALMU(1) = 0,  11.6,      !27Oct98, NRMMII Data Sheet HWVb 09/21/98 OTC-T-044
   BALMD(1) = 0, -13.9,      !27Oct98, NRMMII Data Sheet HWVb 09/21/98 OTC-T-044
!   EQUILF(1)=12714,9638,7778,   !2April98,NRMMII Data Sheet HWVb 1/29/98,
                                 !susp. 2
!   EQUILF(1)=12714,17416,       !Added susp. 2&3 together
!   EQUILF(1)=10461,6271,4551,   !24Sept98, NRMMII Data Sheet HWVb 8/30/98
!   EQUILF(1)=10461,10822,       !Added susp. 2&3 together
!   EQUILF(1)=13014,30276,       !27Oct98 NRMMII Sheet BW1a 8/30/98
                                 !Used loaded vehicle wght., added axle2&3
    EQUILF(1)=13228,32436,  !2Nov98 Used loaded veh. wght. added Axle 2&3
!   CGZ1      = 43.5,            !2April98,NRMMII Sheet HWVa,1/29/98,8/30/98
!   CGZ1      = 55.5,             !27Oct98,NRMMII Sheet HWVa, OTC-T-044, 9/21/98
!                                !Used loaded CGH Wght. :V-cg, Unit-1 wrt grd
   CGZ1      =  55.8,        !2Nov98 Used loaded CGH Wght. NRMMII Sheet HWVa 8/30/98
   CGZ2      =    0,             !V-cg, Unit-2 wrt ground
   DEE1      =  0                !27Oct98, MISSING H-cg, Unit-1 payload wrt hitch
   ZEE1      =  0                !27Oct98, MISSING V-cg, Unit-1 payload wrt grd
   DEE2      =  0                !H-cg, Unit-2 payload wrt hitch
   ZEE2      =  0                !V-cg, Unit-2 payload wrt ground
!   DELTW1    = 14200,            !2April98 NRMMII Sheet HWVa 1/29/98,8/30/98
                    !:Didn't use payload because didn't supply the CG location
   DELTW1    =  0,   !27Oct98 Didn't use payload because didn't supply CG location
   DELTW2    =  0,   !2April98 NRMMII Data Sheet HWVa 1/29/98
!  NPTSC1    = 28,               !2April98 NRMMII Data Sheet HPRF 1/29/98
!                                ! #Pts, bottom profile, Unit-1
!****2April98, NRMMII Data Sheet HPRF 1/29/98**********
!****Special Note 15 is the max number for XCLC1, YCLC1,*******
!    This bottom profile looks low
!  XCLC1(1) =310.2, 307.5, 296.8, 293.7, 293.7,
!             281.8, 281.8, 278.2, 251.1, 251.1,
!             138.9, 138.9, 126.1, 126.1, 122.5,
!              95.3,  95.3,  69.6,  69.6,  66.0,
!              38.8,  38.8,  21.9,  19.8,  15.8,
!              15.8,   3.3,   0.0,
!  YCLC1(1) = 35.25, 34.5,  34.0,  34.0,  30.2,
!              30.2,  18.9,  15.3,  15.3,  19.6,
!              19.6,  26.2,  26.2,  18.9,  15.3,
!              15.3,  24.9,  23.3,  18.9,  15.3,
!              15.3,  31.7,  31.7,  23.4,  23.4,
!              32.4,  32.4,  32.8,
!****2April98, NRMMII Data Sheet HPRF 1/29/98**********
!****Omitted some of the numbers for the bottom profile XCLC1 & YCLC1
!    NPTSC1    = 10,
!   XCLC1(1)=310.2, 293.7, 281.8, 266.7,    243, !from drawing 3April98 Unit-1
!            138.9, 111.0,  54.3,  19.8,      0, !gave us too many numbers
!   YCLC1(1)= 35.25, 30.9,  18.9,  15.3,   19.6, !from drawing 3April98 Unit-1
!             19.6,  15.3,  15.3,  23.4,   32.8,!bottom profile look's LOW
!***24Sept98, NRMMII Data Sheet HPRF 8/30/98************
!****Special Note 15 is the max number for XCLC1, YCLC1,*******
!****** when you have a one unit vehicle******
!   NPTSC1    = 26,
!   XCLC1(1) = 309.4, 304.7, 283.4, 283.4,    279.7,
!              252.6, 252.6, 140.4, 140.4,    127.6,
!              127.6, 124.0,  96.8,  96.8,     71.1,
!               71.1,  67.5,  40.3,  40.3,     24.4,
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!              24.4,  20.4,  20.4,  11.0,    11.0,
!                 0,
!   YCLC1(1) =  36.8,  30.6,  30.6,  19.6,    15.9,
!              15.9,  20.5,  20.3,  26.7,    26.7,
!              19.5,  15.9,  15.9,  25.5,    23.9,
!              19.5,  15.9,  15.9,  32.3,    32.3,
!              23.9,  23.9,  32.3,  32.3,    29.2,
!              29.2,
!****23Oct98, NRMMII Data Sheet HPRF 1/29/98**********
!****Omitted some of the numbers for the bottom profile XCLC1 & YCLC1
!   NPTSC1    = 15,
!   XCLC1(1) = 309.4, 304.7, 283.4, 279.7, 252.6,
!             252.6, 140.4, 127.6, 124.0,  96.8,
!              40.3,  24.4,  20.4,  11.0,     0,
!   YCLC1(1) =  36.8,  30.6,  30.6,  15.9,  15.9,
!              20.5,  20.3,  19.5,  15.9,  15.9,
!             15.9,  23.9,  23.9,  29.2,  29.2,
!***2Nov98, NRMMII Sheet HPRF 8/30/98*********
!***Omitted some of the numbers for the bottom profile XCLC1 & YCLC1
  NPTSC1    = 15,
  XCLC1(1) =381.3,  376.3, 355.3, 351.7, 324.6,
            324.6,  167.6, 163.9,  80.3,  80.3,
             20.4,  20.4,   11.0,  11.0,   0.0,
  YCLC1(1) = 36.8,   30.6,  30.6,  15.9,  15.9,
             20.5,   19.5,  15.9,  15.9,  23.7
             23.7,   32.2,  32.2,  29.1,  29.1,
  NPTSC2    =,                ! #Pts, bottom profile, Unit-2
  XCLC2(1) =,
  YCLC2(1) =,
  SFLAG(4) = 0,             ! Type suspension front "spridler" (always zero)
  IP(4,1)  =,               ! Power flag, front "spridler"
  IB(4,1)  =,               ! Brake flag, front "spridler"
  ELL(4)   =,               ! H-pos front "spridler" wrt hitch
  ZS(4)    =,               ! V-pos centerline front "spridler" wrt ground
  EFFRAD(4)=,               ! Effective radius front "spridler" measure from
!                            ! centerline to outher edge of track
  SFLAG(5) = 0,             ! Type suspension rear "spridler" (always zero)
  IP(5,1)  =,               ! Power flag, rear "spridler"
  IB(5,1)  =,               ! Brake flag, rear "spridler"
  ELL(5)   =,               ! H-pos rear "spridler" wrt hitch
  ZS(5)    =,               ! V-pos centerline rear "spridler" wrt ground
  EFFRAD(5)=,               ! Effective radius rear "spridler" measure from
                            ! centerline to outher edge of track
 $END
 M1095(trler only)made trl with wheel under the trl tongue,made all power 22Apr2
 $VEHICL
! 22April02  fake veh. made this unit with an extra wheel and powered, oshxlwb
!            is the second vehicle unit
! RB.Ahlvin WES/MSD 24Nov93
! Comments: can't use comments before the $VEHICL line.
!         : use only after the $VEHICL line
  NUNITS =  1,     ! Number of units
  NSUSP  =  2,     ! Number of suspension supports
  NVEH1  =  1,     ! Vehicle type; 0=tracked, 1=wheeled
  NFL    =  0,     ! Track type; 0=rigid, 1=flexible
  REFHT1 = 34,     ! Height of hitch from ground
  HTCHFZ =    0,   ! V-force on hitch
  SFLAG(1) = 0,1,  ! Type susp @supt-i,0=indp,1=bogie
! Power flags ((IP(i,j), i=1,nsusp) j=1,2)
  IP(1,1)  =1,0,0,0,0,  !23Apr02, made the trailer powered
  IP(1,2)  =1,0,0,0,0,
! Brake flags ((IB(i,j), i=1,nsusp) j=1,2)
  IB(1,1)  = 1,0,0,0,0, !26April99, corrected
  IB(1,2)  = 1,0,0,0,0,
  EFFRAD(1)=23.45,23.45,   !Eff. loaded radius whls
  ELL(1)   =0 -163,     !Horiz. pos. suspension WRT hitch
  BWIDTH(1)=0, 56   !Bogie arm length (centerline wheel to centerline wheel)
  BALMU(1) =  0, 10,          !Bogie max CCW. angl, (+=CCW.)
  BALMD(1) =  0,-10,          !Bogie max CW. angl, (+=CCW.)
  EQUILF(1)= 9550,9550,       !Equilibrium force
  CGZ1      =     60.1,       ! V-cg, Unit-1 wrt ground
  CGZ2      =  0,           ! V-cg, Unit-2 wrt ground
  DEE1      =  0,           ! H-cg, Unit-1 payload wrt hitch
  ZEE1      =  0,           ! V-cg, Unit-1 payload wrt ground
  DEE2      =  0,           ! H-cg, Unit-2 payload wrt hitch
  ZEE2      =  0,           ! V-cg, Unit-2 payload wrt ground
  DELTW1    =  0,           ! Payload weight, Unit-1
  DELTW2    =  0,           ! Payload weight, Unit-2
  NPTSC1    =  8,          ! #Pts, bottom profile, Unit-1
  XCLC1(1) = 0,    -16,    -16, -223,  -223,     !Unit-1
           -228,    -228, -230.6,
```

```
   YCLC1(1) =34,     34,    37,    37,    26,      !Unit-1
             26,     40,    40,
   NPTSC2   =,              !#Pts, bottom prof.
   XCLC2(1) =,
   YCLC2(1) =,
   SFLAG(4) = 0,            ! Type suspension front "spridler" (always zero)
   IP(4,1)  =,              ! Power flag, front "spridler"
   IB(4,1)  =,              ! Brake flag, front "spridler"
   ELL(4)   =,              ! H-pos front "spridler" wrt hitch
   ZS(4)    =,              ! V-pos centerline front "spridler" wrt ground
   EFFRAD(4)=,              ! Effective radius front "spridler" measure from
                            ! centerline to outher edge of track
   SFLAG(5) = 0,            ! Type suspension rear "spridler" (always zero)
   IP(5,1)  =,              ! Power flag, rear "spridler"
   IB(5,1)  =,              ! Brake flag, rear "spridler"
   ELL(5)   =,              ! H-pos rear "spridler" wrt hitch
   ZS(5)    =,              ! V-pos centerline rear "spridler" wrt ground
   EFFRAD(5)=,              ! Effective radius rear "spridler" measure from
                            ! centerline to outher edge of track
 $END
 ************************************************************************
 **** 17April02, This file is for the USMC HIMARS project for Randy Jones****
 **** the JMTK(SWIMCRIT)information is for the truck ONLY.          ********
 **** Does NOT include the JMTK(SWIMCRIT)data for the trailer data  ********
 ************************************************************************
OSHXLWB
!<Include 60-character vehicle title as first line of data>
!
! CAMMS/NRMM-II Linear-feature vehicle data                Form: 4 Aug 91
! This is the format and content for the vehicle data required to run the
! linear-feature (gap-crossing) prediction model in the CAMMS/NRMM-II
! system.  The format is FORTRAN Namelist input format.  The specific
! syntax is as documented in the VAX/VMS fortran and is similiar for
! most FORTRAN compilers that implement namelist input.  The actual input
! is handled by an emulator which is coded in standard fortran-77.  An
! extension to the standard syntax is to ignore the "!" and all text
! information following the "!" for the remainder of the input line.
! This file can be used as the skeleton for the actual input data file
! and should read O-K as is.
!      This data should be placed at end of normal NRMM-II vehicle file
! (after the obstacle performance matrix data) to create the complete CAMMS/
! NRMM-II data set.
! <The comment lines from here to just after the vehicle title may be deleted>
!
! Vehicle description:OSHKOSH XLWB(extra long wheel base)
! Changes: 3Apr02 changed the vlen from 386.5" to 415" for SWIMCRIT
!
!
! Date entered:04/01/02  Entered by:______________ Checked by:______________
!
! Updates:______________________________________________________________________
!
 $LFVDAT
! Over-all description:
   IVTYPE=      1 , ! 1=wheeled, 2=flex-track, 3=gird-track
   IVCONF=      2 , ! if wheeled; 1=4x4, 2=6x6, 3=8x8
                    ! if tracked; 1=Normal, 2=Dozer, 4=Comb. 1&2
   GVW    =  45664, ! BW1a gross vehicle weight {lbs}
   VVCI1 =    30.7, ! Vehicle 1-pass VCI for fine-grained soils {RCI}
! Geometry:Vegetation
!   VLEN  = 386.5, ! HWVa 8/30/98,Over-all length {in}
   VLEN    =   415, ! 3Apr02, For Swimcrit extended leng from 386.5 to 415"
                    ! Over-all leng in.
   VWIDTH =  97.4, ! HWVa 8/30/98,Over-all width {in}
   VAADEG =     20, ! Esti. from picture Approach/departure angle {deg}
   VCLR   =     29, ! Esti. from picture Frame end clrance ("clrance line"){in}
   VRR    =     23, ! Esti. Roadwheel radius (+track-thickness if tracked){in}
   VTL    =244.25, ! HWVa Front-rear grd whl center-line distance {in}
   VCGF   = 153.6, ! drawing, Horizontal-distance C-G to frt-whl ctr-ln{in}
   VCGH   =     29, ! Esti. Verticle-distance C-G to frt-whl center-line{in}
! Wheeled vehicle additional geometry data
   WHLGWS =187.75, ! drawing, Distance between wheels of greatest span {in}
   WBCLR  = 16.73, ! BW1a, Clrance between whls of greatest span{in}
! Tracked vehicle additional data
   TRKLEN =       , ! Length of track on ground (one-side) {in}
   TRKWID =       , ! Width of one track (one-side) {in}
   TRKD   =       , ! Hull depth above end clearance line {in}
   KTPAD  =       , ! Track pad code 1=HAS-pads; 0=NO-pads
! Tracked vehicle sprocket/idler configuration for non-dozer (i.e. IVCONF=1,4)
   RR1    =       , ! Sproket/idler radius {in}
   RR2    =       , ! Horizontal-dist. road-wheel ctr. to sproket/idler ctr. {in}
```

```
  RR3    =       , ! Verticle-dist. road-wheel ctr. to sproket/idler ctr. {in}
! Swimming/fording characteristics
  VSWIM  =     0, ! Vehicle swim speed (0.=NON-SWIMMER) {mph}
  VFORD  =      , ! Vehicle fording speed (pre-set to 5mph)
  DFLOAT =    60, ! WCR1, 8/30/98, Vehicle maximum fording debth {in}
 $ END
```

Appendix B
Digital Terrain Information

Introduction

The TeleEngineering Toolkit supports U.S. Geological Survey (USGS) Digital Orthophoto Quadrangle data, National Oceanic and Atmospheric Administration (NOAA) Global Digital Elevation Model (DEM) data, and data products from the National Imagery and Mapping Agency (NIMA). NIMA data products include ARC Digitized Raster Graphics (ADRG), Compressed ADRG/Controlled Image Base (CADRG/CIB), Digital Nautical Chart (DNC), Digital Topographic Elevation Data (DTED), Digital Topographic Data (DTOP), Feature Foundation Data (FFD), Interim Terrain Data (ITD), Planning Interim Terrain Data (PITD), Urban Vector Map (UVMAP), Vector Interim Terrain Data (VITD), and Vector Map (VMAP) Levels 0 and 1. Brief descriptions, with definitions obtained from the product sources' websites, are in Table B1 and the following listing.

Table B1
TeleEngineering Toolkit Supported Digital Mapping Products

Data Product	Data Types/Scales/Layers	Definition/Description
ADRG ARC Digitized Raster Graphics	(ARC4) GNC 1:5,000,000	Equal Arc second Raster Chart/Map Digitized Raster Graphics (ARDG) are raster representations of paper graphic products converted into digital data by raster scanning. Single map/chart series and scale data are maintained as a worldwide seamless database of raster graphic data.
	(ARC1) JNC 1:2,000,000	
	(ARC1) ONC 1:1,000,000	
	(ARC2) TPC 1:500,000	
	(ARC2) LFC 1:500,000	
	(ARC2) VNC 1:500,000	
	(ARC5) JOG 1:250,000	
	ATC 1:200,000	
	(ARC6) TLM 1:100,000	
	(ARC7) TLM 1:50,000	

(Sheet 1 of 4)

Table B1 (Continued)

Data Product	Data Types/Scales/Layers	Definition/Description
CADRG/CIB Compressed ADRG/Controlled Image Base	1:5M GNC Global Navigation Chart 1:2M JNC Jet Navigation Chart 1:1M ONC Operation Navigation Chart 1:500K TPC Tactical Pilotage Chart 1:500K LFC Low Flying Chart (UK) 1:250K JOG Joint Operations Graphic 1:250K TFC Transit Flying Chart (UK) 1:200K ATC Series 200 Air Target Chart 1:100K TLM-100 Topographic Line Map 1:50K TLM-50 Topographic Line Map 10m CIB10 Controlled Image Base 5m CIB5 Controlled Image Base 1m CIB1 Controlled Image Base	General-purpose product, comprising computer-readable digital map and chart images. CIB is a seamless dataset of orthophotos, made from rectified grayscale aerial images.
DNC Digital Nautical Chart	Cultural Landmarks Earth Cover Environment Hydrography Inland Waterways Land Cover Limits Aids to Navigation Obstructions Port Facilities Relief	A vector-based digital database containing maritime significant features essential for safe marine navigation. Initial data collection of the database is from a portfolio of approximately 5,000 nautical charts that will ultimately provide global marine navigation between 84 deg North latitude and 81 deg South latitude and support a variety of Geographic Information System applications.
DTED Digital Topographic Elevation Data	Level 0 Level I Level II	Uniform matrix of digital terrain elevation data provided in 1 X 1 deg cells, produced at three different levels of detail. Level 0 post spacing is 30 arc seconds. Level I post spacing is 3 arc seconds (approx. 100 m). Level II post spacing is 1 arc second (approx. 30 m).
DTOP Digital Topographic Data Levels 1 through 5	Beach Boundaries Hydrography Industry Obstacles Population Slope/Surface Configuration Surface Drainage Surface Materials Transportation Utilities Vegetation	DTOP1 is intended for strategic level planning, initial operations and analysis, and crisis support. DTOP2 is intended for 1:250,000 scale map background displays and situational awareness. DTOP3 is designed for terrain analysis, battlefield visualization, and automated decision-making. DTOP4 provides 1:50,000 scale map background display and hardcopy production and situational awareness. DTOP5 supports full-scale, joint, combined warfighting operations.

(Sheet 2 of 4)

Table B1 (Continued)

Data Product	Data Types/Scales/Layers	Definition/Description
FFD Feature Foundation Data	Boundaries Elevation Hydrography Population Transportation Vegetation Data Quality	Vector data extracted from imagery equivalent to a 1:50,000 scale product and density equivalent to a 1:250,000 scale product.
GLOBE DEM Global Digital Elevation Model	Level I Level II Level III Level IV	Global Land One-kilometer Base Elevation Digital Elevation Model is a global raster data set with horizontal grid spacing of 30 arc-seconds (0.008333... deg)
ITD Interim Terrain Data	Transportation Drainage Surface Material/Configuration Slope Vegetation Obstacles	Contiguous digital datasets covering specified geographic areas whose attributed and unsymbolized feature information is equivalent to the content of Tactical Terrain Analysis Data Bases (TTADBs)
PITD Planning Interim Terrain Data	Transportation Drainage Surface Material/Configuration Slope Vegetation Obstacles	Digital datasets with feature information equivalent to the content of Planning Terrain Analysis Data Bases (PTADBs) with normal data collection density of 1:250,000
USGS DOQs Digital Orthophoto Quadrangles	USGS DOQ 1:12,000 Color USGS DOQ 1:12,000 Grayscale	Computer-generated images of aerial photographs with displacements from camera orientation and terrain removed.
UVMAP URBAN Vector Map	Boundaries Elevation Hydrography Industry Physiography Population Transportation Utilities Vegetation	Designed to provide vector-based geospatial data with city graphic content.
VITD Vector Interim Terrain Data	Obstacles Slope/Surface Configuration Soil/Surface Materials Surface Drainage Transportation Vegetation	Designed to provide terrain analysis data for systems requiring digital terrain information on CD-ROM and which are being fielded prior to NIMA full-scale production DTOP. It consists of contiguous digital data sets covering specified geographic areas.

(Sheet 3 of 4)

Table B1 (Concluded)		
Data Product	**Data Types/Scales/Layers**	**Definition/Description**
VMAP Vector Map Level 0	Boundaries Elevation Hydrography Industry Physiography Population Transportation Utilities Vegetation	An updated and improved version of the NIMA's Digital Chart of the World (DCW). The VMap Level 0 database provides worldwide coverage of vector-based geospatial data as viewed at 1:1,000,000 scale. It consists of geographic, attribute, and textual data stored on compact disk read-only memory.
VMAP Vector Map Level 1	Boundaries Elevation Hydrography Industry Physiography Population Transportation Utilities Vegetation	Designed to provide vector-based geospatial data at medium resolution.

(Sheet 4 of 4)

Sources

www.drewfoster.com/pages/rgbhex.html - RGB Hex Color Chart

/mapping.usgs.gov/www/rdop – Digital Orthophoto Program; U.S. Geological Survey, U.S. Department of the Interior, Reston, VA

www.ngdc.noaa.gov/seg/topo/report - GLOBE DEM
Hastings, David A., and Paula K. Dunbar, 1999. Global Land One-kilometer Base Elevation (GLOBE) Digital Elevation Model, Documentation, Volume 1.0. Key to Geophysical Records Documentation (KGRD) 34. National Oceanic and Atmospheric Administration, National Geophysical Data Center, 325 Broadway, Boulder, Colorado 80303, U.S.A.

www.nima.mil/publications/specs/printed/89007/89007_ADRG.pdf - ARC Digitized Raster Graphics (ADRG); Military Specification MIL-A-89007; 22 Feb 1990

http://www.nima.mil/publications/specs/printed/89014A/89014A_ITD.pdf - Interim Terrain Data (ITD) / Planning Interim Terrain Data (PITD); Performance Specification MIL-PRF-89014A; 15 March 1996

http://www.nima.mil/publications/specs/printed/89020B/89020B.pdf - Digital Terrain Elevation Data (DTED); Performance Specification MIL-PRF-89020B; 23 May 2000

http://www.nima.mil/publications/specs/printed/89041/PRF89041.pdf - Controlled Image Base (CIB); Performance Specification MIL-PRF-89041A; 28 March 2000

http://www.nima.mil/publications/specs/printed/89023/89023.pdf - Digital Nautical Chart; Performance Specification MIL-PRF-89023; 19 Dec 1997

http://www.nima.mil/publications/specs/printed/89038/89038_CADRG.pdf - Compressed ARC Digitized Raster Graphics (CADRG); Military Specification MIL-C-89038; 6 October 1994

http://www.nima.mil/publications/specs/printed/89037/MIL-PRF-89037A.pdf - Digital Topographic Data (DTOP); Performance Specification MIL-PRF-89037A; 1 Aug 2002

http://www.nima.mil/publications/specs/printed/89033/VMAP_89033.pdf - Vector Smart Map (Vmap) Level 1; Performance Specification MIL-PRF-89033; 1 June 1995

http://www.nima.mil/publications/specs/printed/89035a/MIL-PRF-89035A.pdf - Urban Vector Map (UVMap); Performance Specification MIL-PRD-89035A; 1 August 2002

http://www.nima.mil/publications/specs/printed/89039/PRF_8903.PDF - Vector Smart Map (VMap) Level 0; Performance Specification MIL-PRF-89039; 9 February 1995

http://www.nima.mil/publications/specs/printed/89040a/89040A_VITD.pdf - Vector Product Interim Terrain Data (VITD); Performance Specification MIL-PRF-89040A; 8 May 1996

http://www.nima.mil/publications/specs/draft/ffd/ffd30nov98.pdf - Foundation Feature Data (FFD) Associated Performance Specification Draft MIL-PRF-89049/1; 30 November 1998

Appendix C
Vehicle Performance Plots

Introduction

The results of the Toolkit evaluations were used to analyze routing results to show performance differences in the selected corridors, contrast routing results with existing mission levels, and recommend mission profiles for U.S. Marine Corps (USMC) High Mobility Artillery Rocket System (HIMARS) deployment scenarios. The Mission Rating Speed (MRS) was used as a vehicle performance indicator, the Mission Severity Rating (MSR) was used as a mission level indicator, and the terrain types encountered during mission operations were used to create the mission profiles. The MRS and MSR used a 100-percent value as the terrain challenge level and the average speed over 100 percent of each terrain type encountered.

The results presented in the following series of charts explain the mission analyses for the Medium Tactical Vehicle Replacement (MTVR) and Logistics Vehicle System (LVS) operating in the Germany, Korea, and Iraq terrains for different mission scenarios, in both a dry normal and wet normal weather scenario, with and without a trailer. The charts represent a performance relationship between the vehicle's safest composite velocity defined by the MRS and the percentage of terrain types encountered during its mission defined by the Mission Severity Index (MSI). The charts indicate the level of severity for each standard mission and show these standard mission levels as reference lines for comparison to the selected vehicle mission. The average MRS and MSI are shown for each vehicle and vehicle configuration to indicate the general level of mission difficulty and vehicle performance. It must be noted that the composite velocity, defined by MRS and as explained in Chapter 2, is the fastest possible velocity the vehicle could safely achieve at maximum engine RPM.

The results presented in the following series of charts show the percentage of the total mission that each terrain type encountered. The four terrains, primary and secondary roads and trails and cross-country, are shown as a percentage of the total mission distance for both weather scenarios and vehicle configurations.

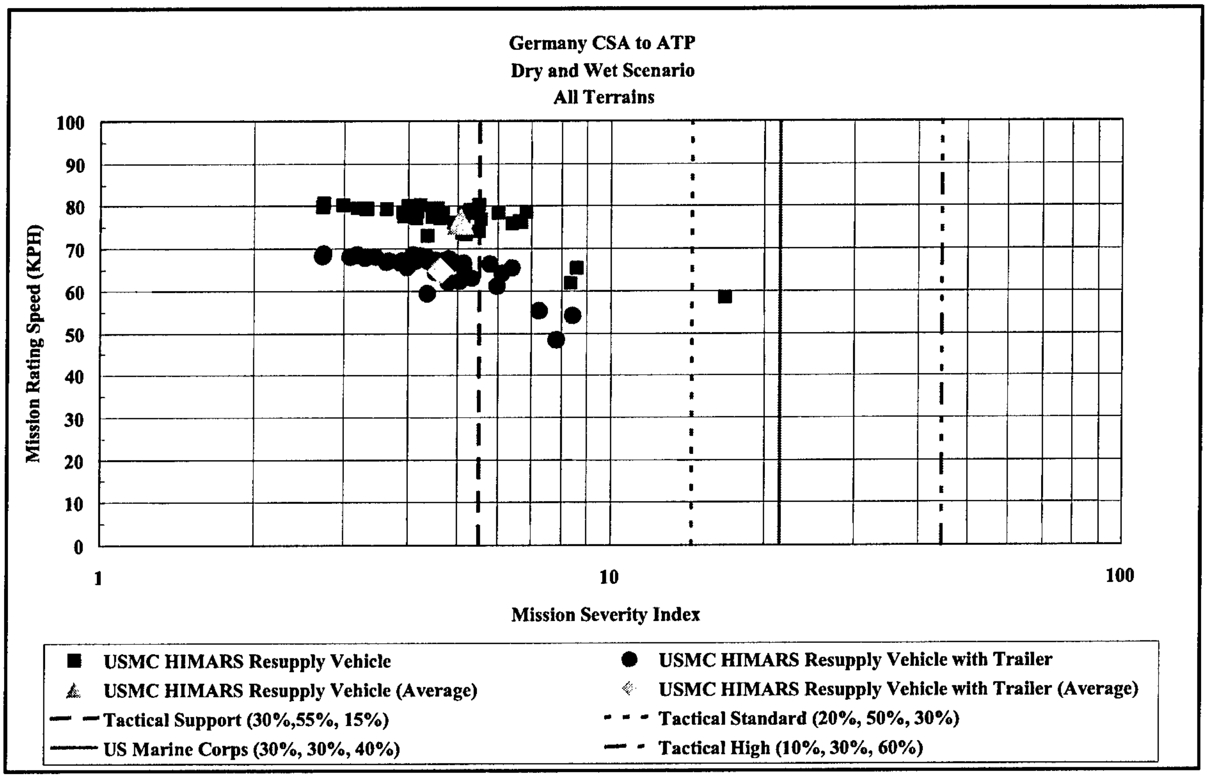


Figure C1. Performance chart for the HIMARS vehicle operating from Corps Storage Area (CSA) to Ammunition Transport Point (ATP) in Germany

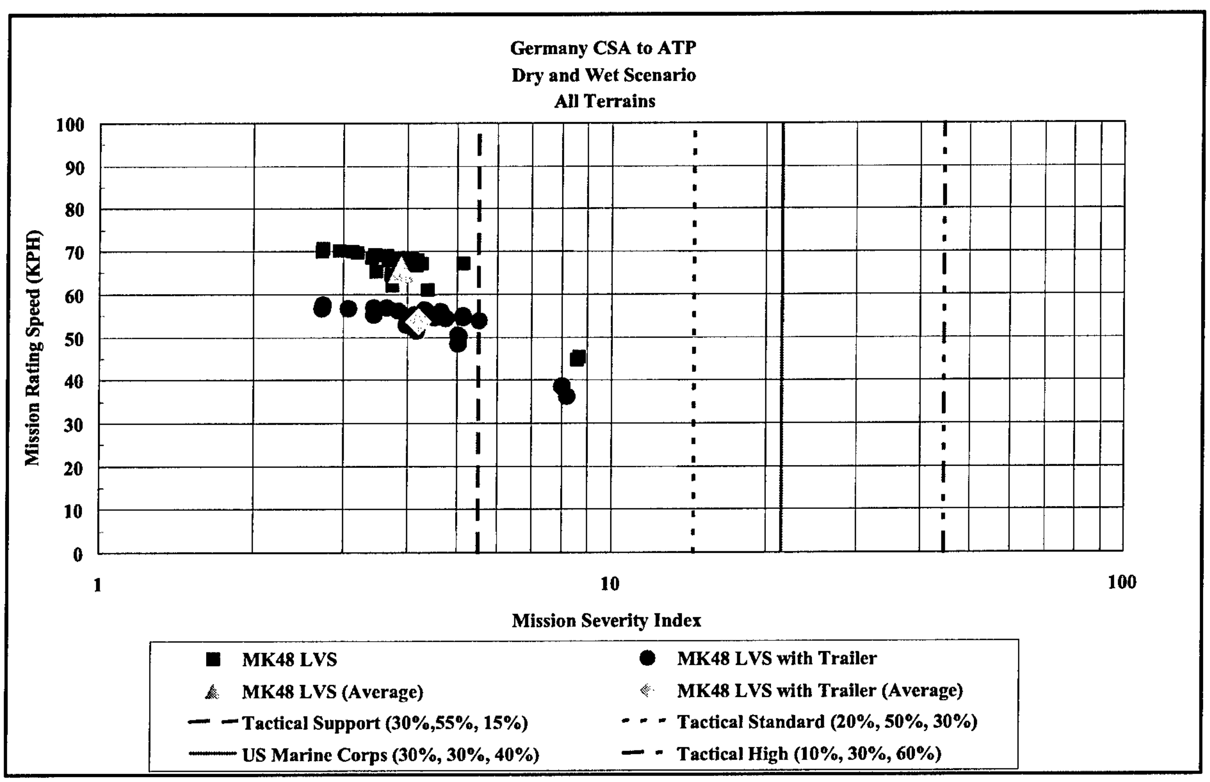


Figure C2. Performance chart for the MK48 vehicle operating from CSA to ATP in Germany

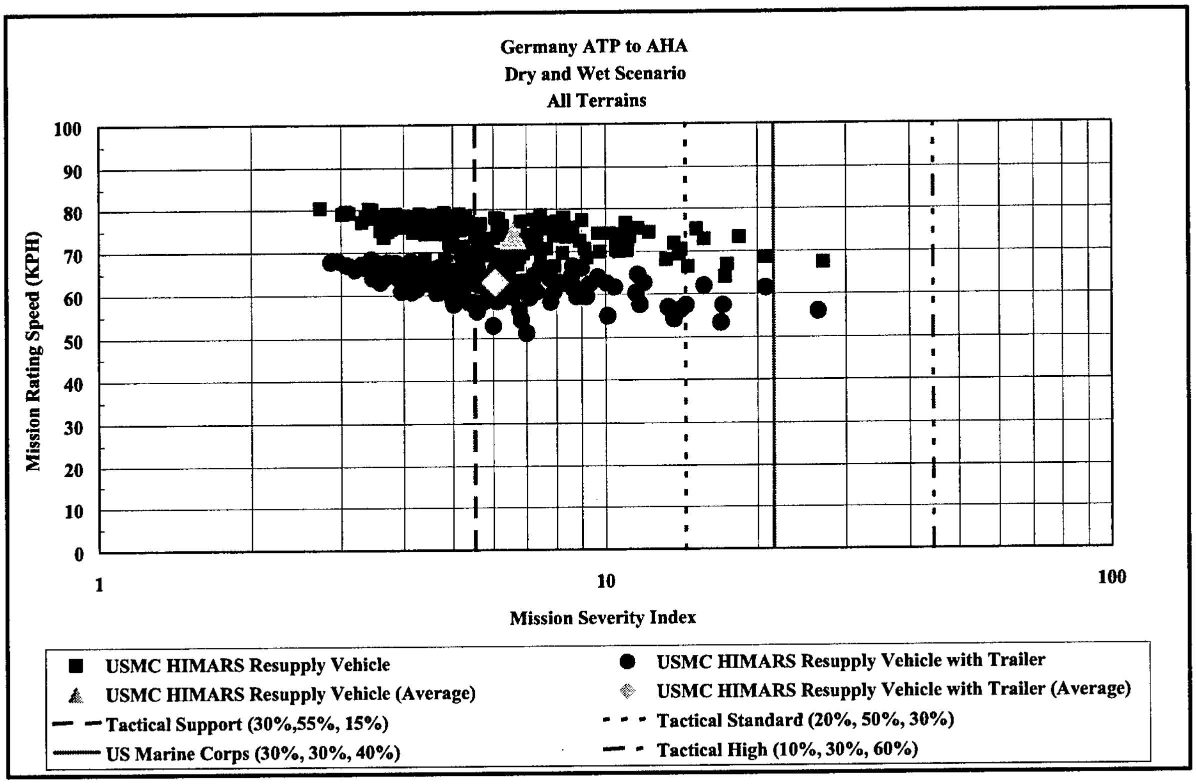


Figure C3. Performance chart for the HIMARS vehicle operating from ATP to Ammunition Holding Area (AHA) in Germany

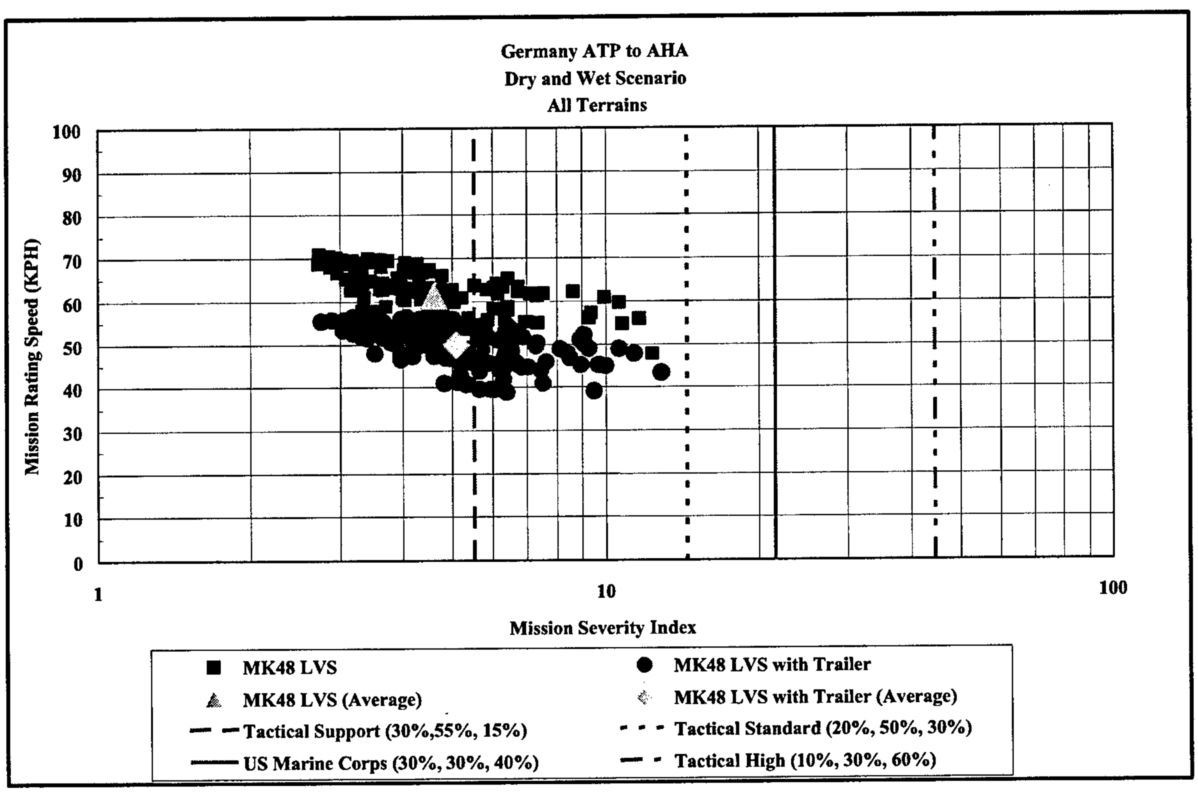


Figure C4. Performance chart for the MK48 vehicle operating from ATP to AHA in Germany

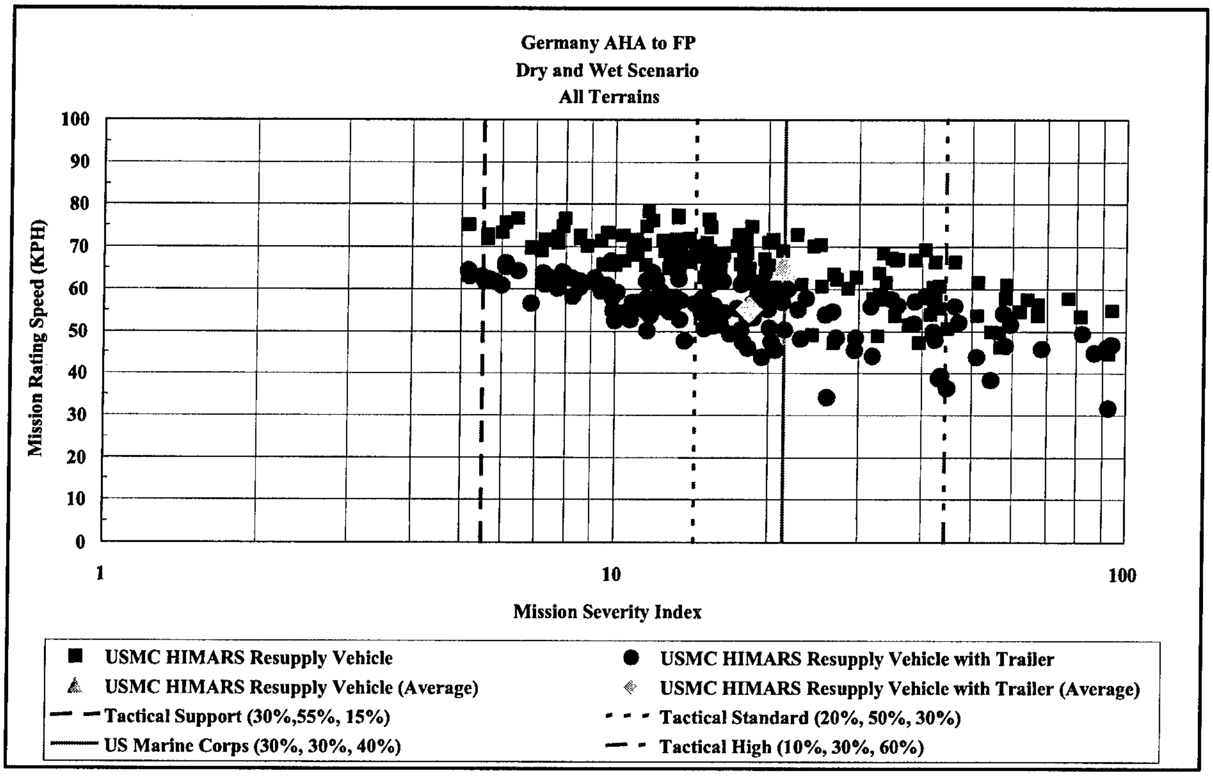


Figure C5. Performance chart for the HIMARS vehicle operating from AHA to Firing Points (FP) in Germany

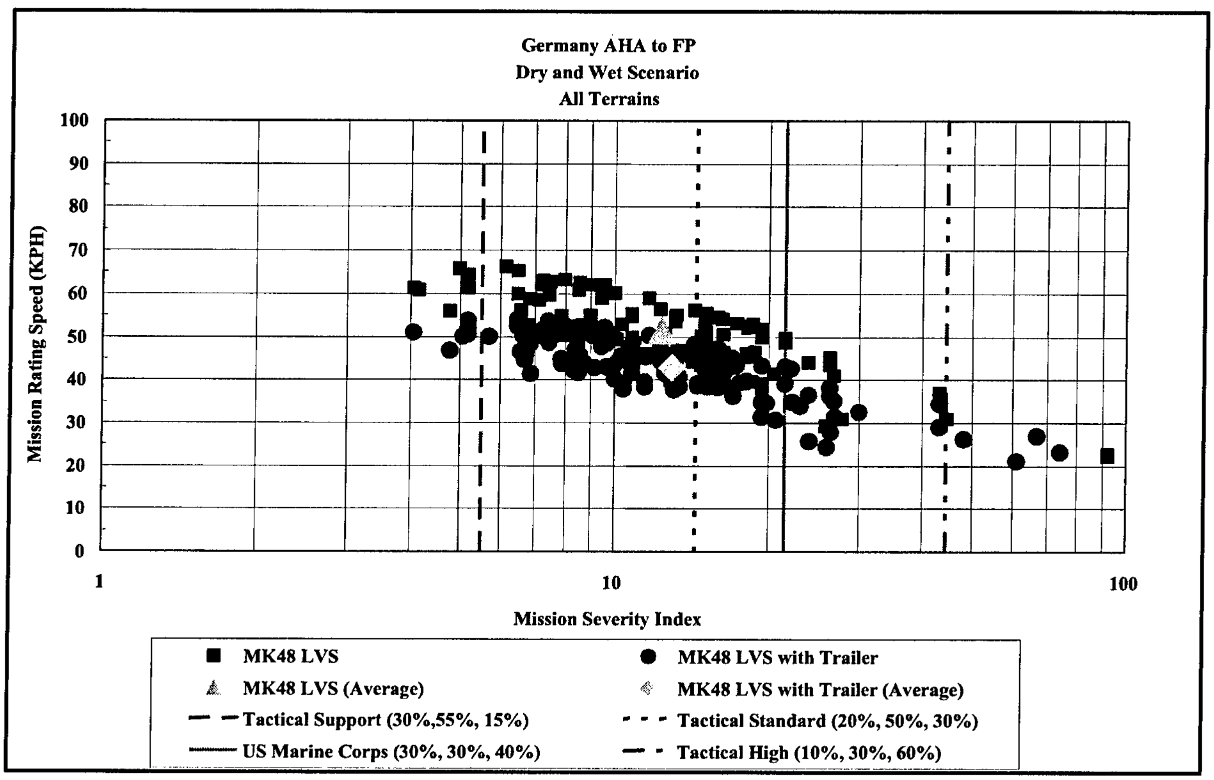


Figure C6. Performance chart for the MK48 vehicle operating from ATP to FP in Germany

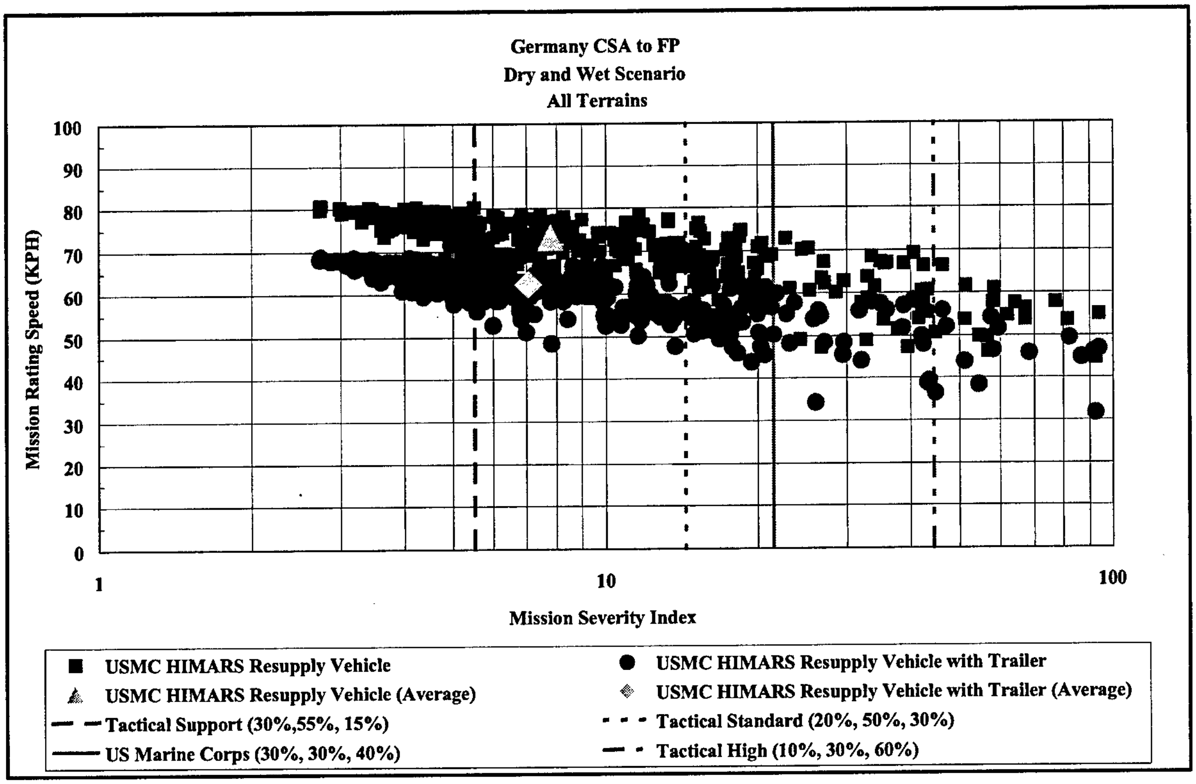


Figure C7. Performance chart for the HIMARS vehicle operating from CSA to FP in Germany

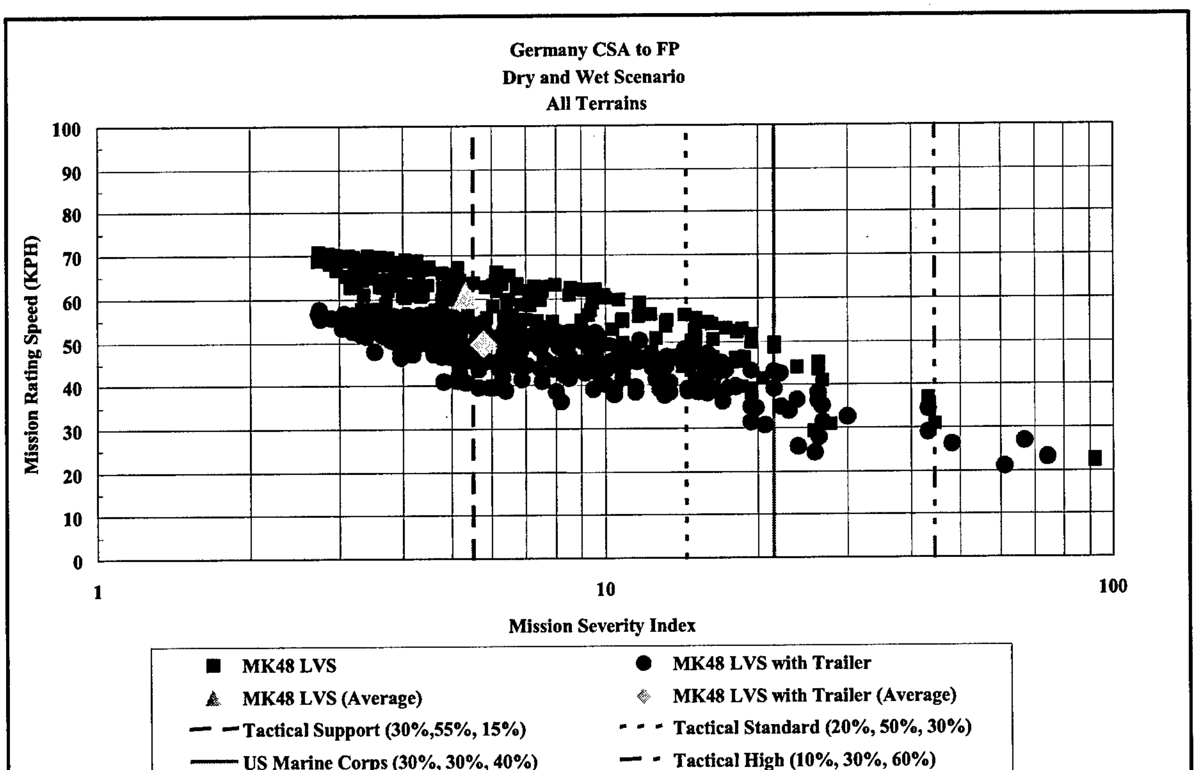


Figure C8. Performance chart for the MK48 vehicle operating from CSA to FP in Germany

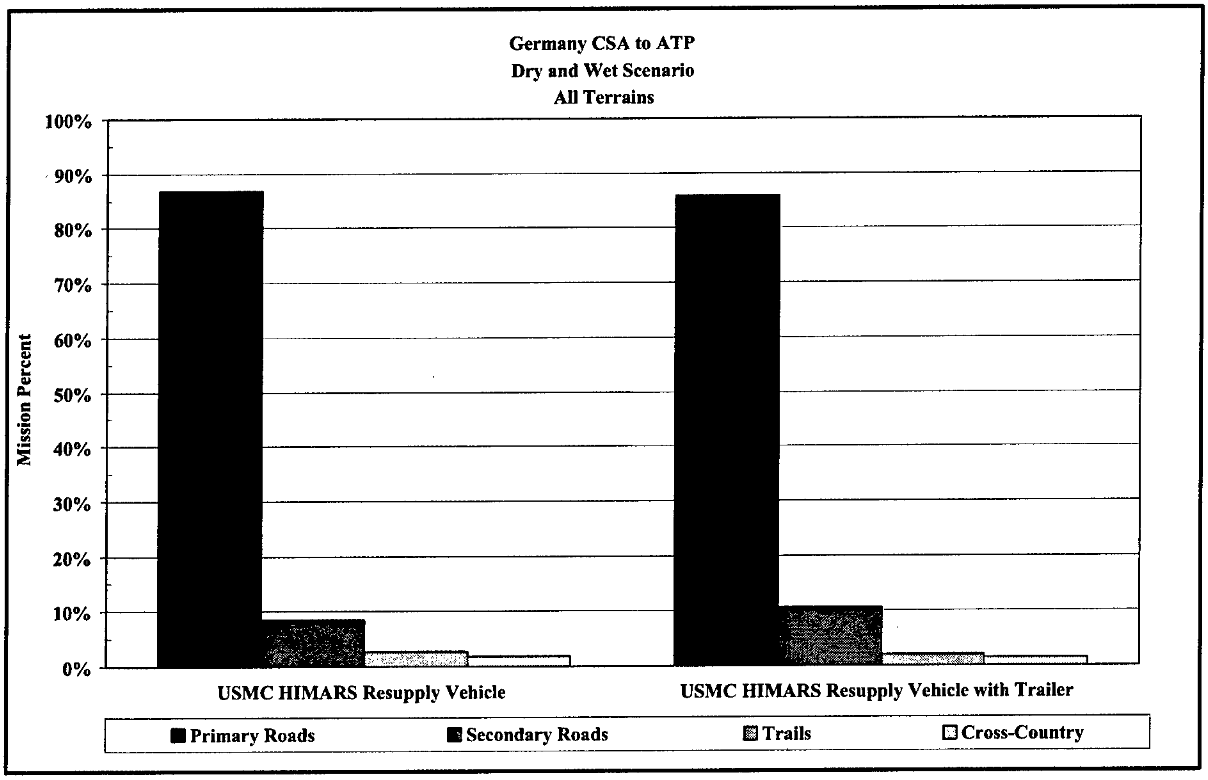


Figure C9. Terrains encountered by the HIMARS vehicle operating from CSA to ATP in Germany

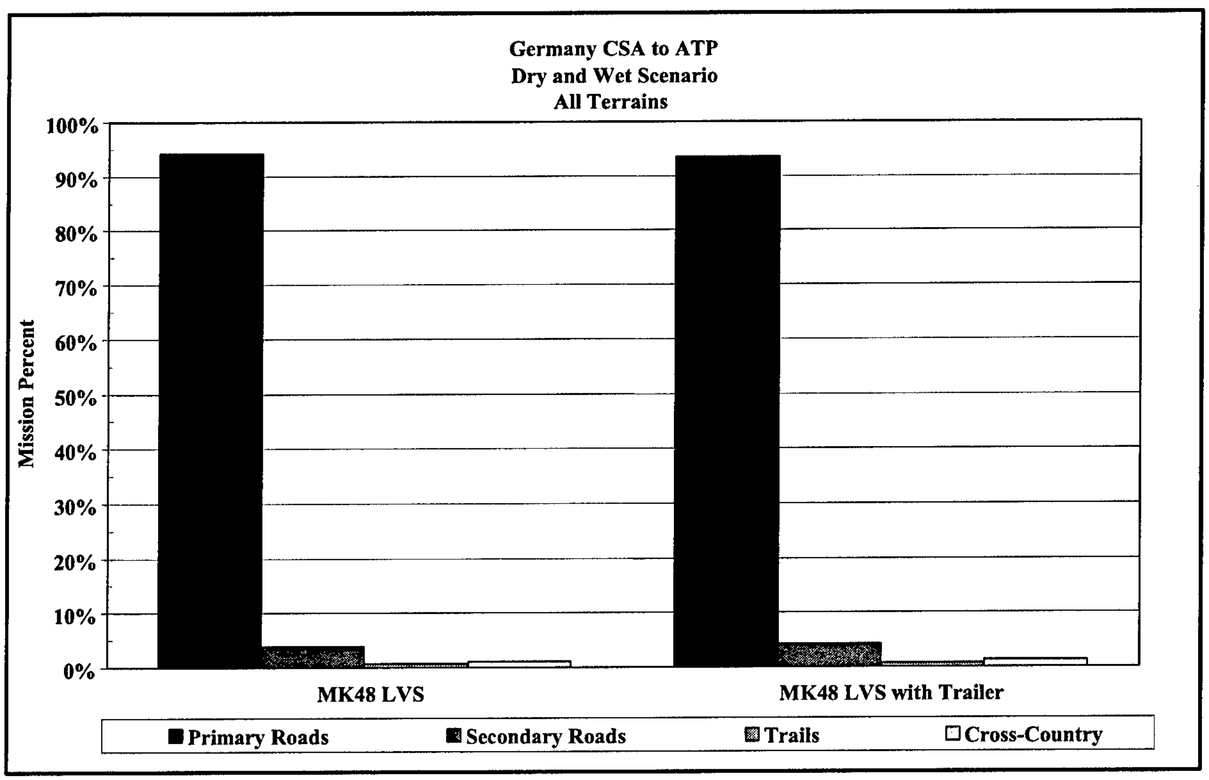


Figure C10. Terrains encountered by the MK48 vehicle operating from CSA to ATP in Germany

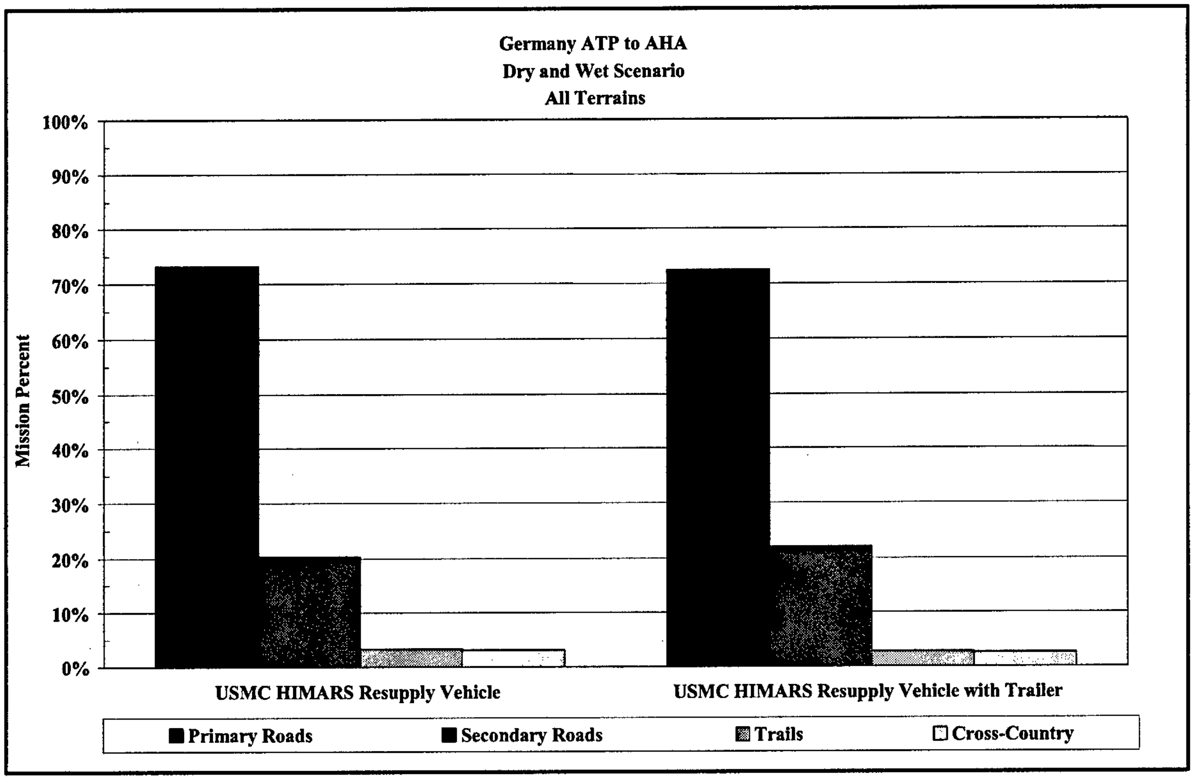


Figure C11. Terrains encountered by the HIMARS vehicle operating from ATP to AHA in Germany

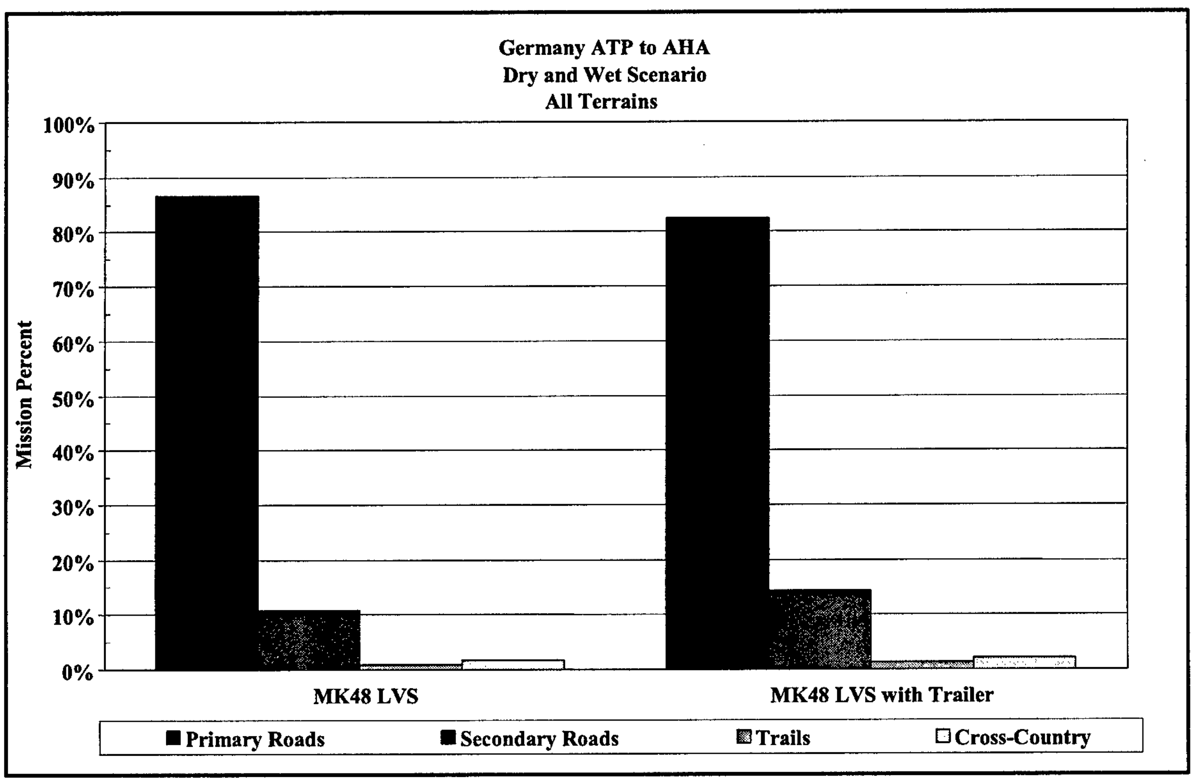


Figure C12. Terrains encountered by the MK48 vehicle operating from ATP to AHA in Germany

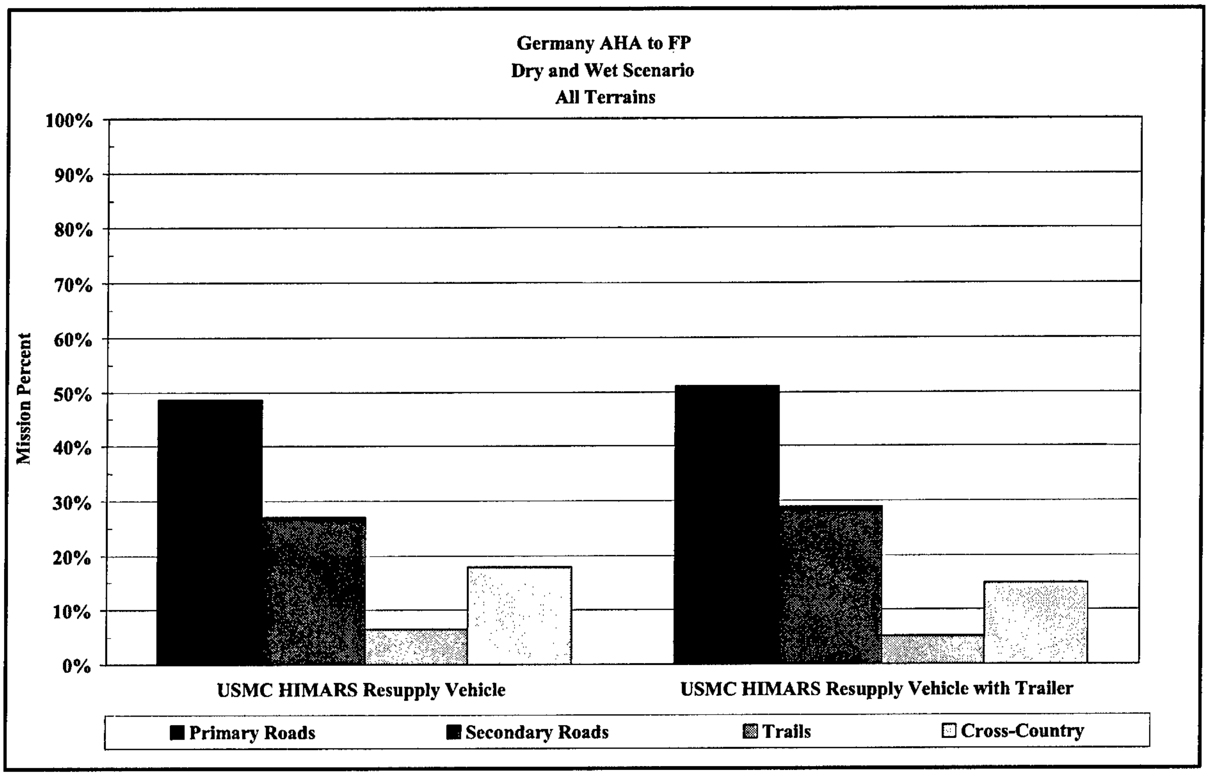


Figure C13. Terrains encountered by the HIMARS vehicle operating from AHA to FP in Germany

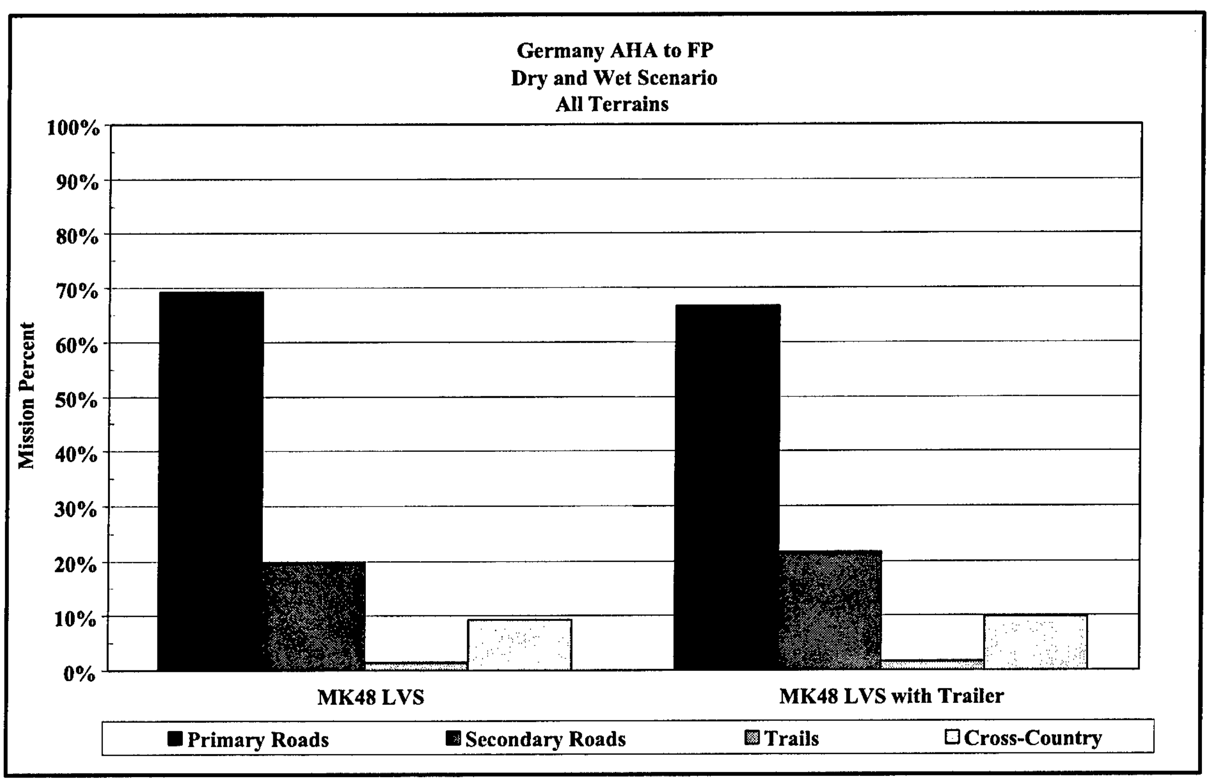


Figure C14. Terrains encountered by the MK48 vehicle operating from the AHA to FP in Germany

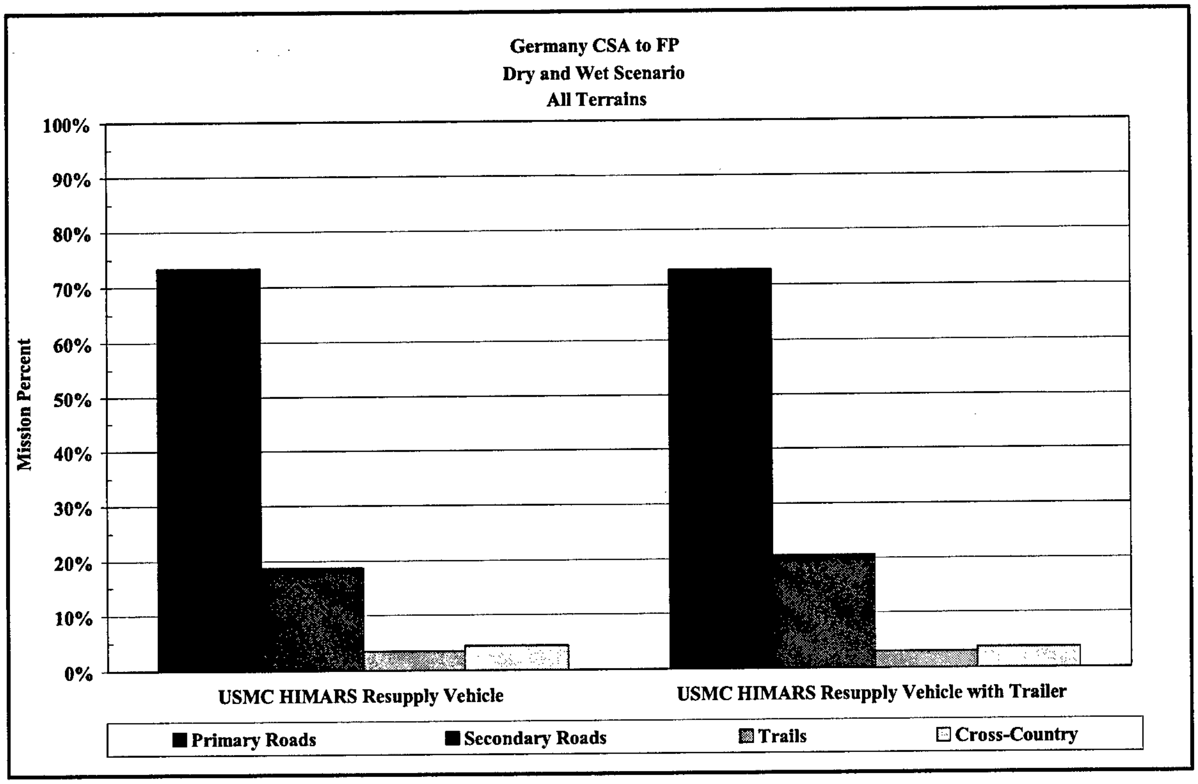


Figure C15. Terrains encountered by the HIMARS vehicle operating from CSA to FP in Germany

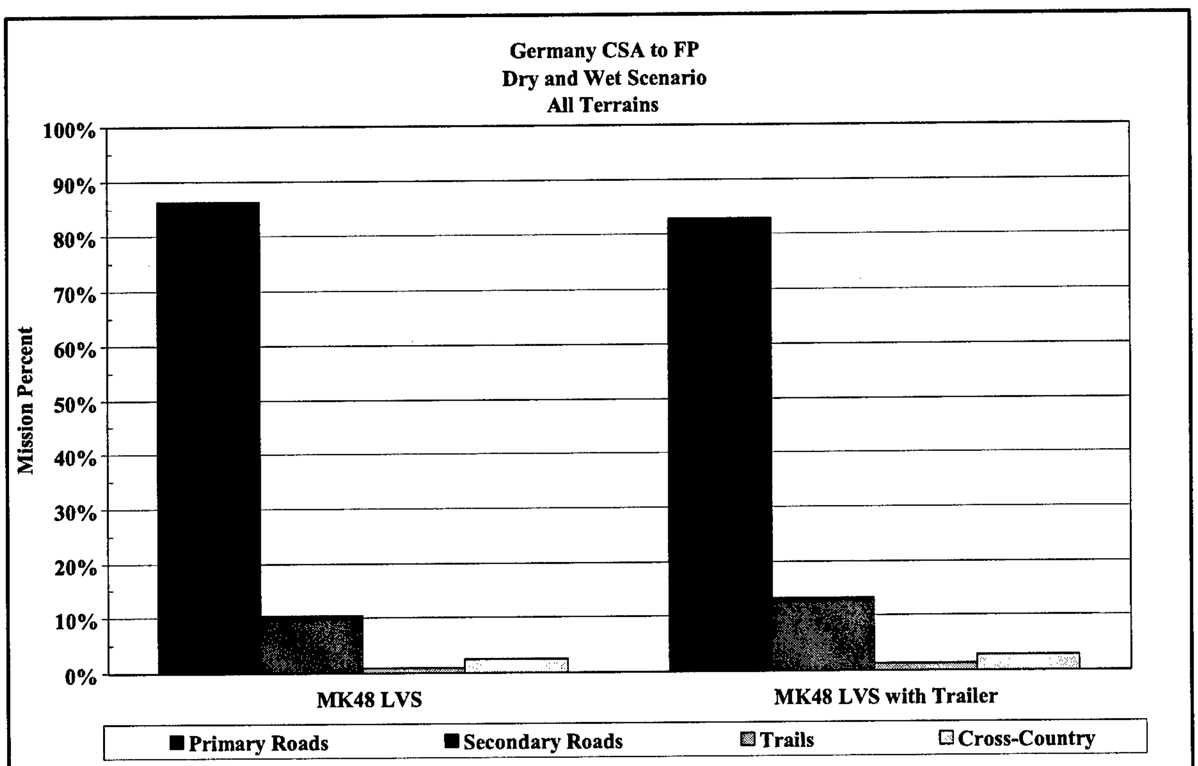


Figure C16. Terrains encountered by the MK48 vehicle operating from the CSA to FP in Germany

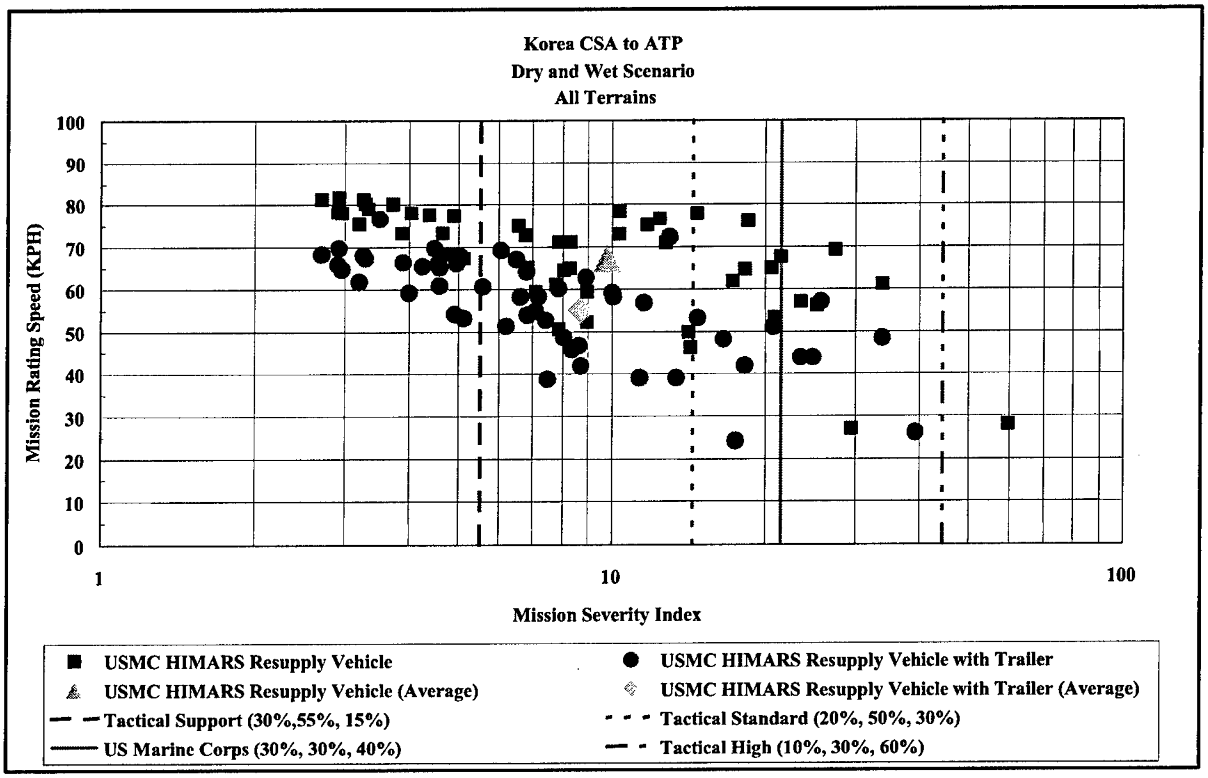


Figure C17. Performance chart for the HIMARS vehicle operating from CSA to ATP in Korea

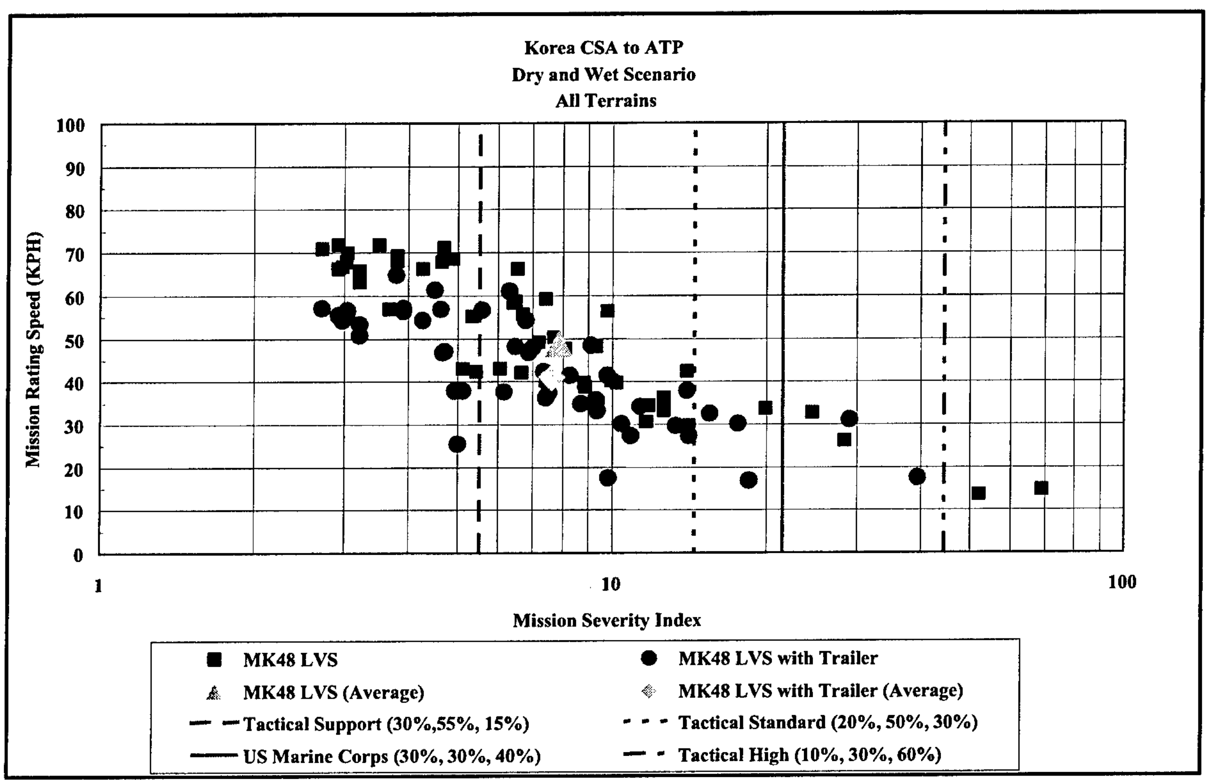


Figure C18. Performance chart for the MK48 vehicle operating from CSA to ATP in Korea

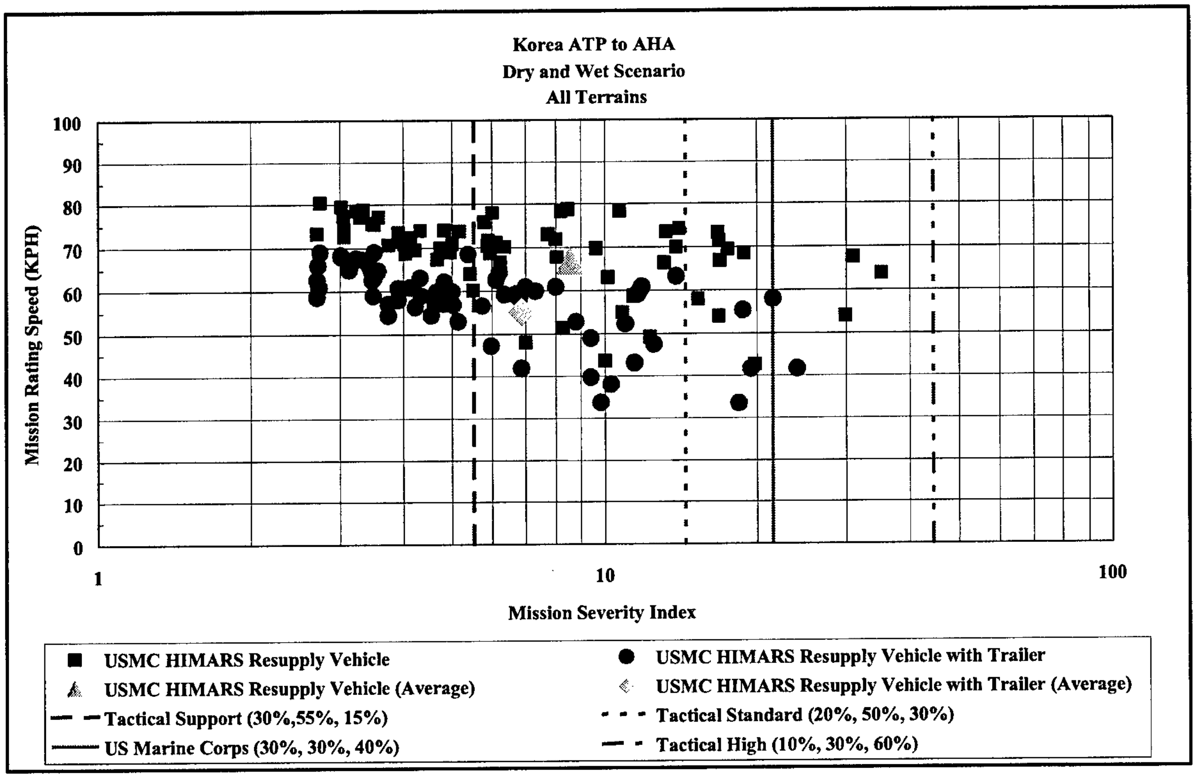


Figure C19. Performance chart for the HIMARS vehicle operating from ATP to AHA in Korea

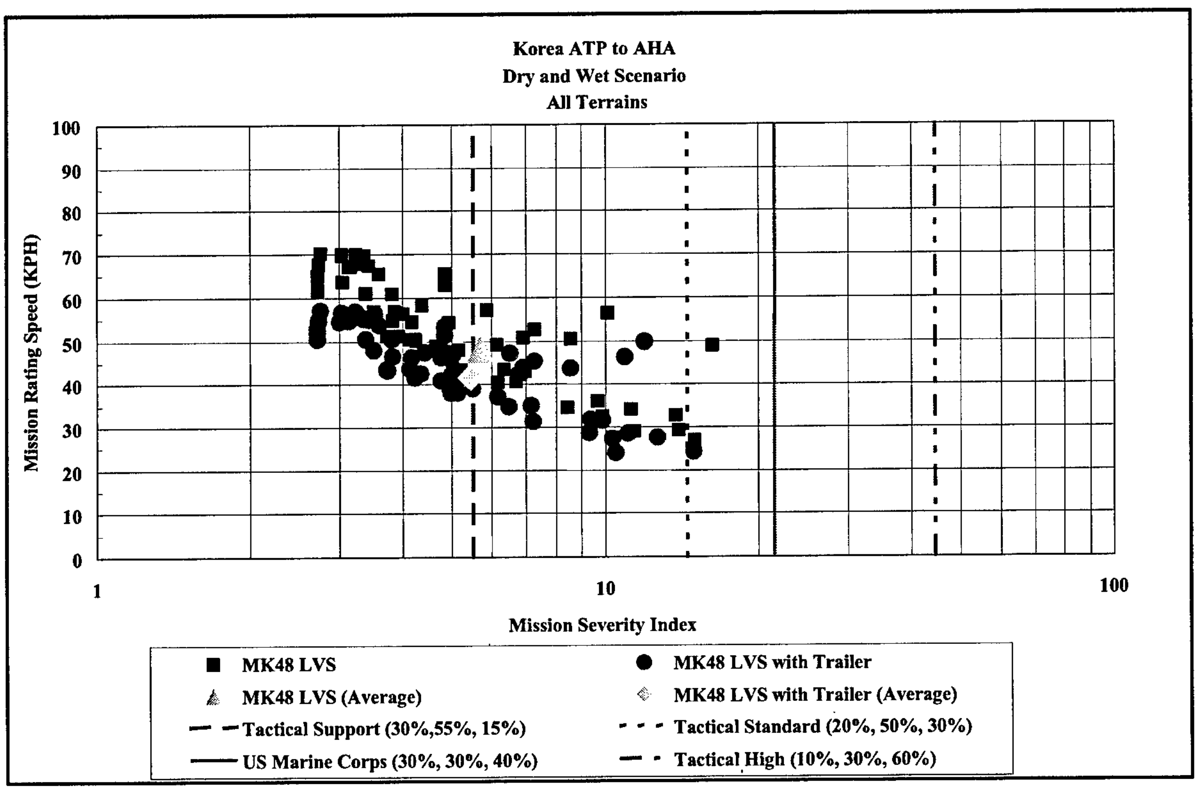


Figure C20. Performance chart for the MK48 vehicle operating from ATP to AHA in Korea

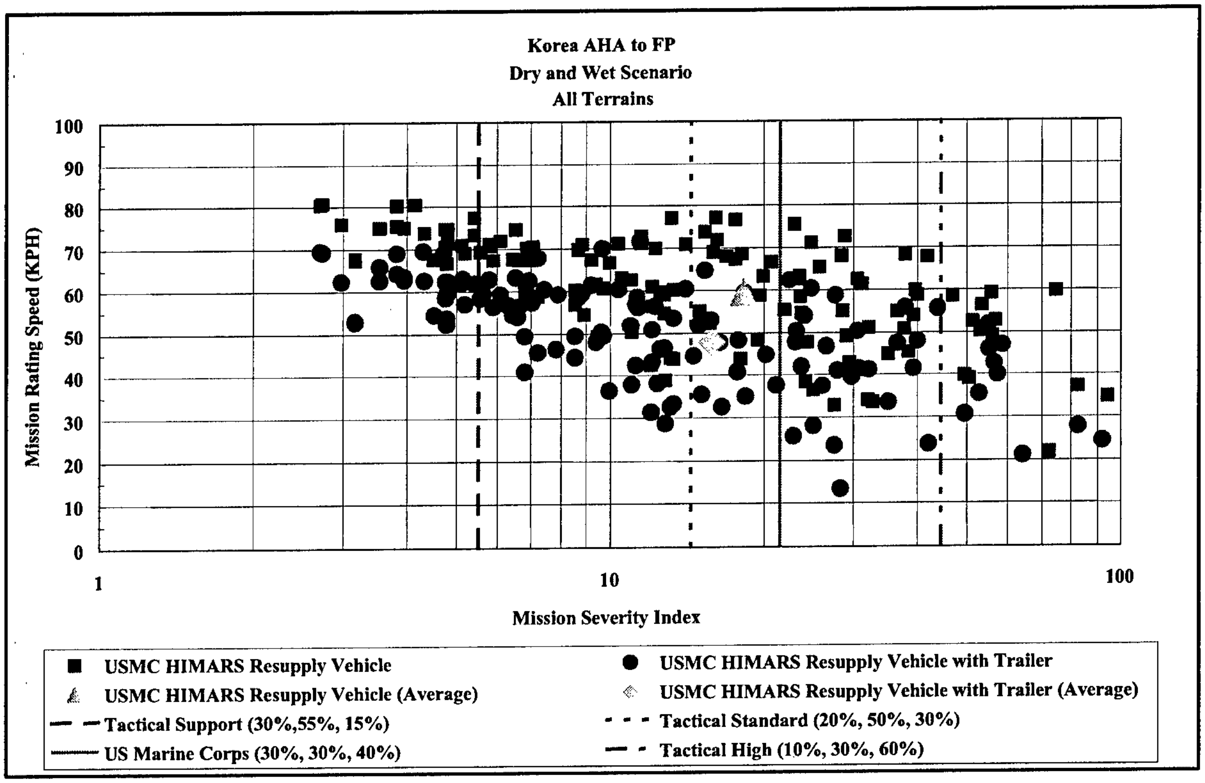


Figure C21. Performance chart for the HIMARS vehicle operating from AHA to FP in Korea

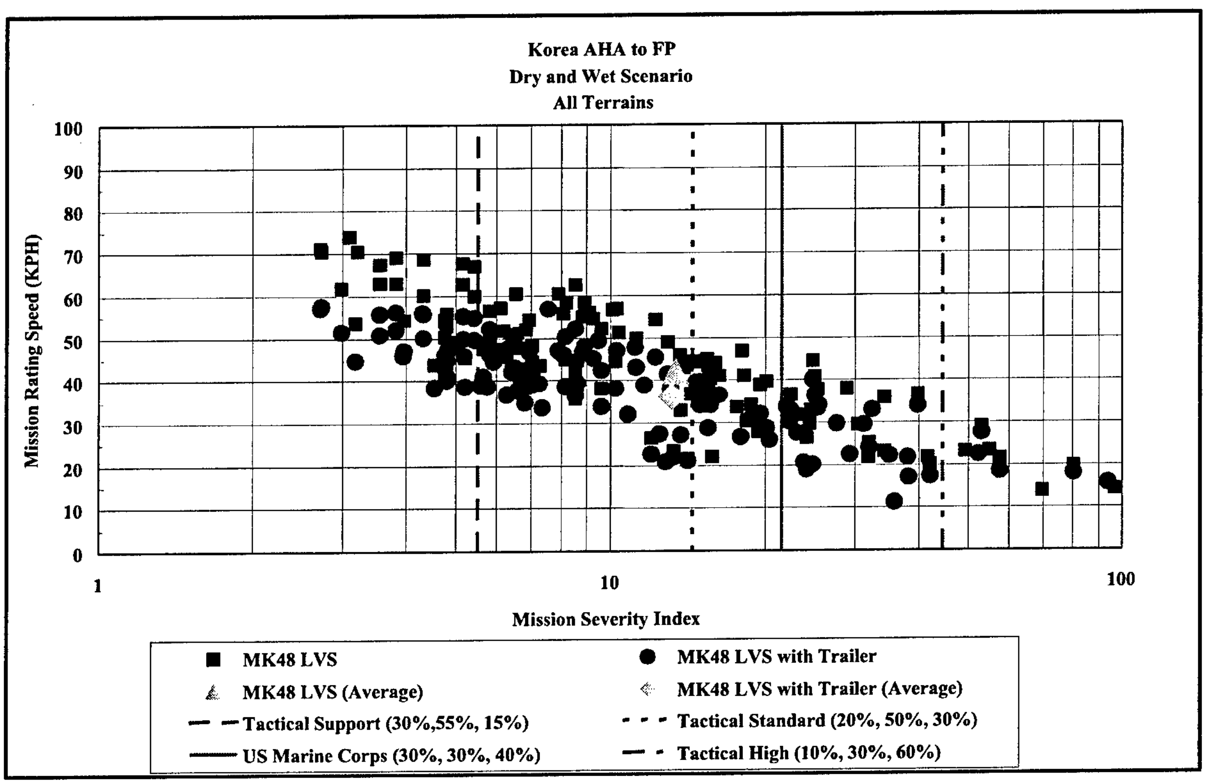


Figure C22. Performance chart for the MK48 vehicle operating from AHA to FP in Korea

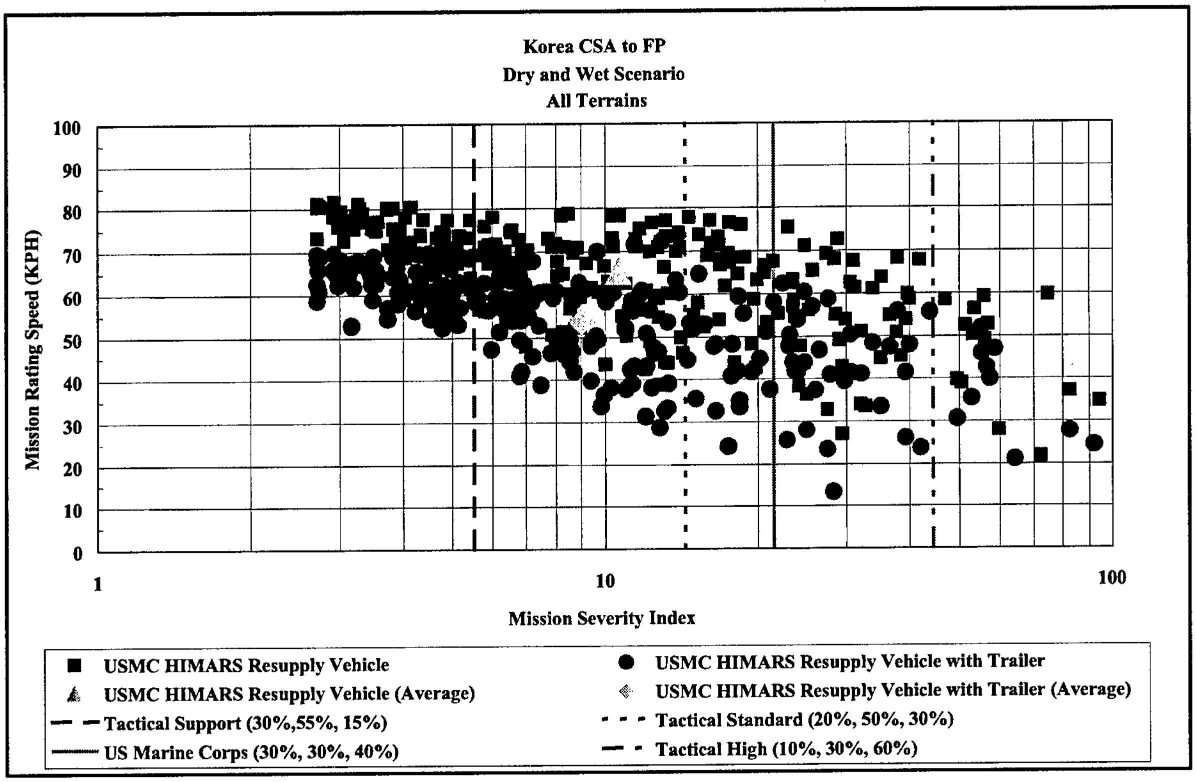


Figure C23. Performance chart for the HIMARS vehicle operating from CSA to FP in Korea

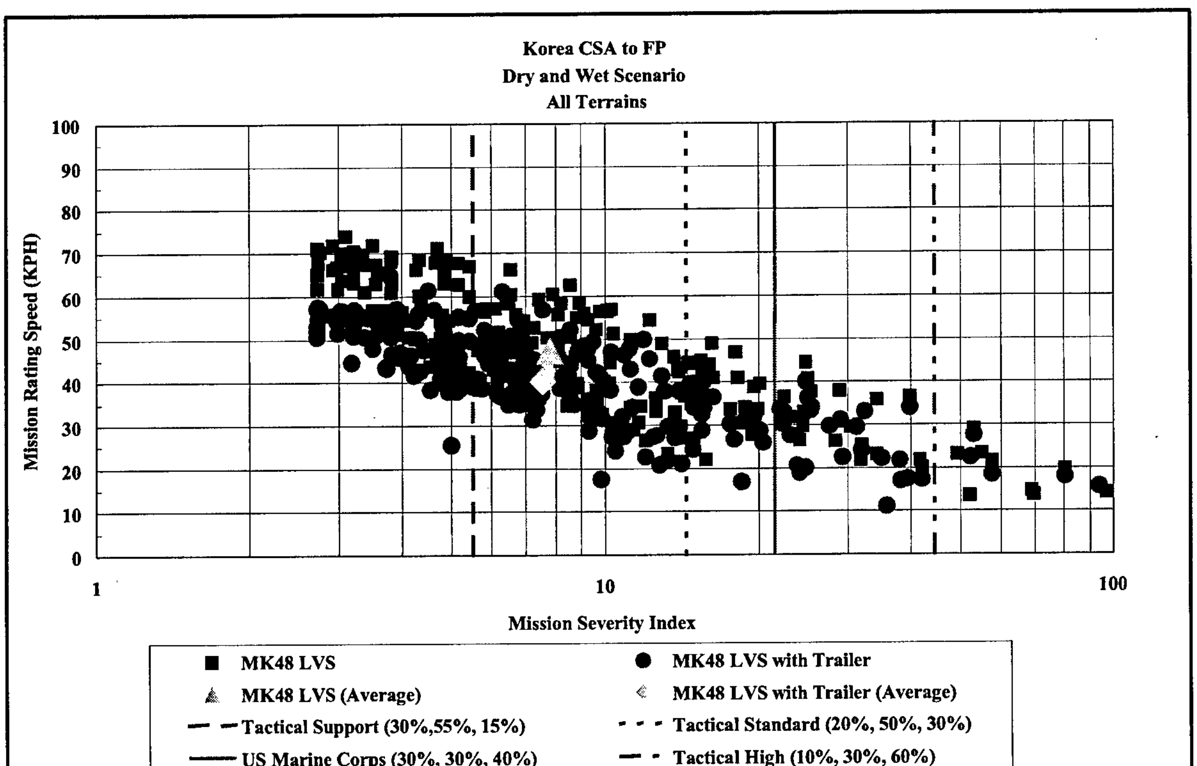


Figure C24. Performance chart for the MK48 vehicle operating over CSA to FP in Korea

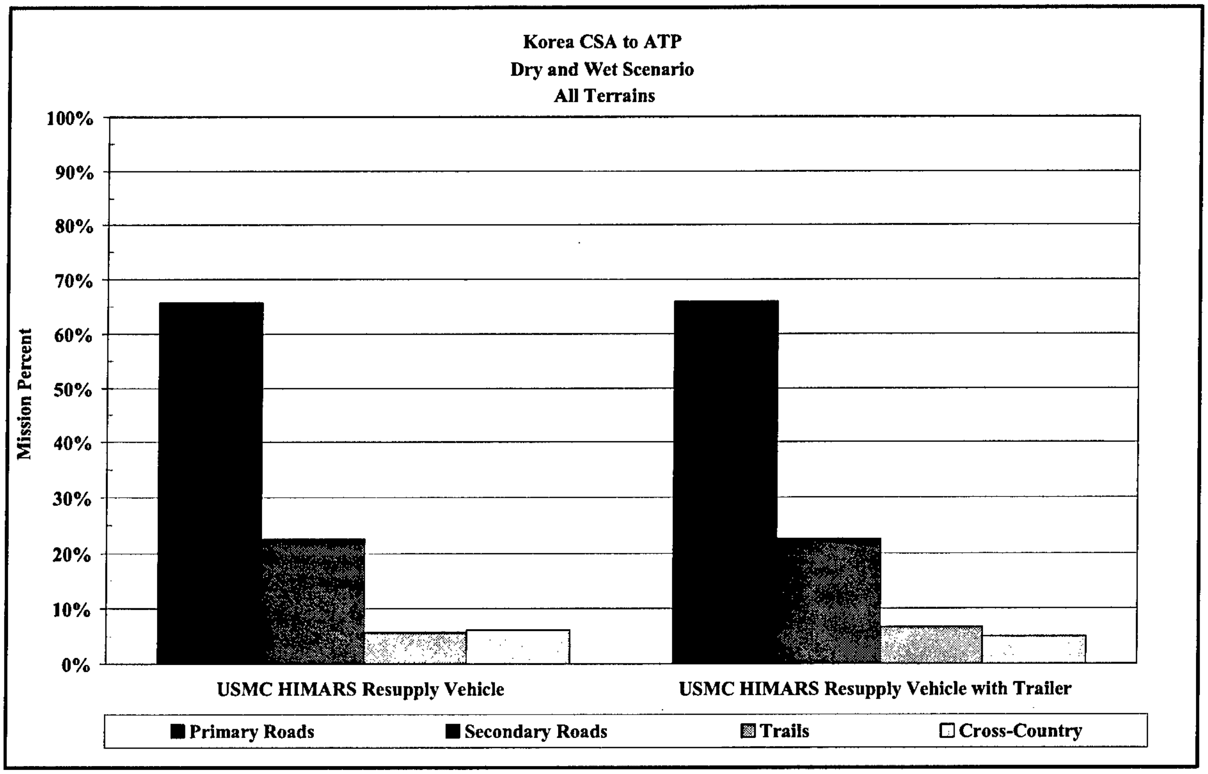


Figure C25. Terrains encountered by the HIMARS vehicle operating over selected missions

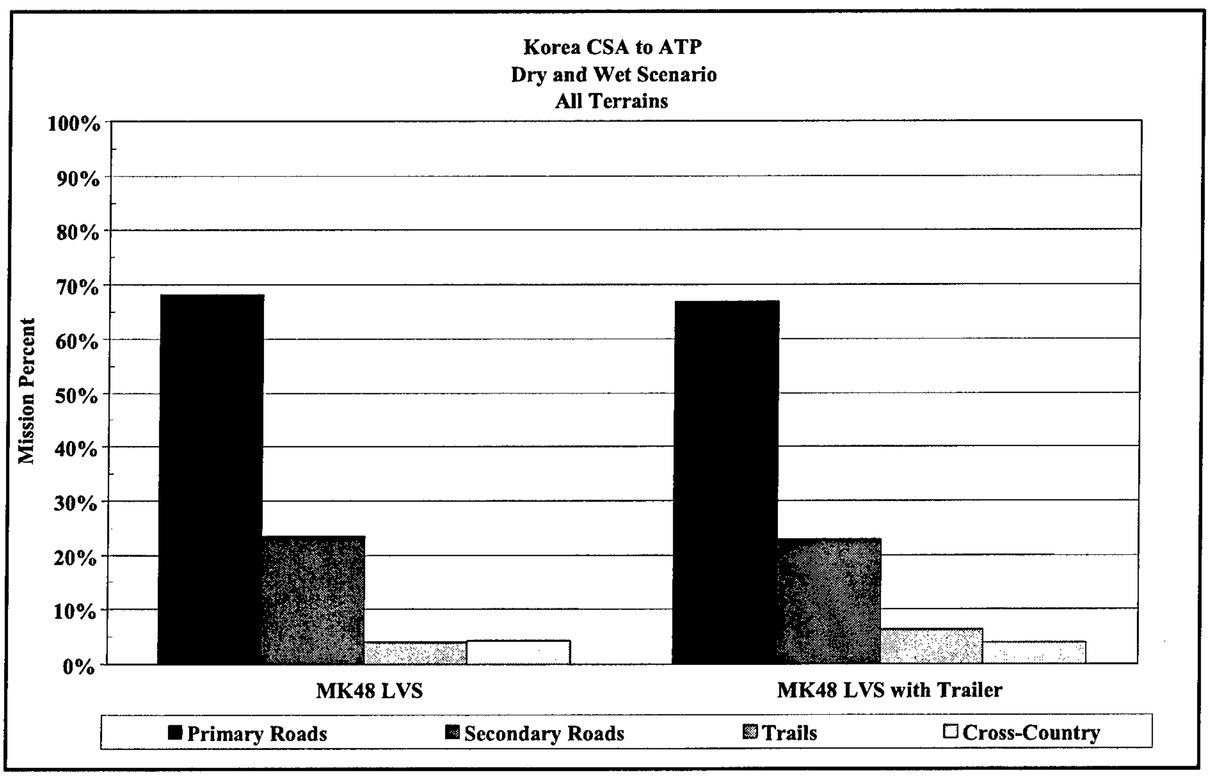


Figure C26. Terrains encountered by the MK48 vehicle operating from CSA to ATP in Korea

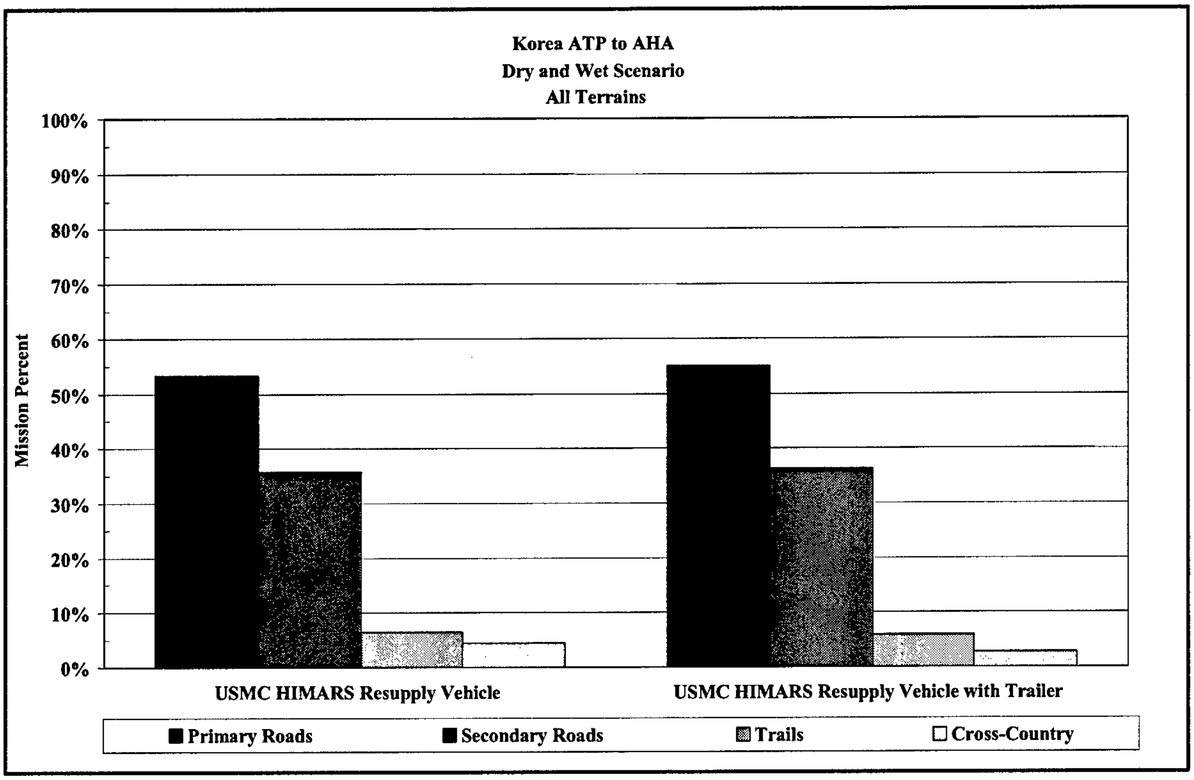


Figure C27. Terrains encountered by the HIMARS vehicle operating from ATP to AHA in Korea

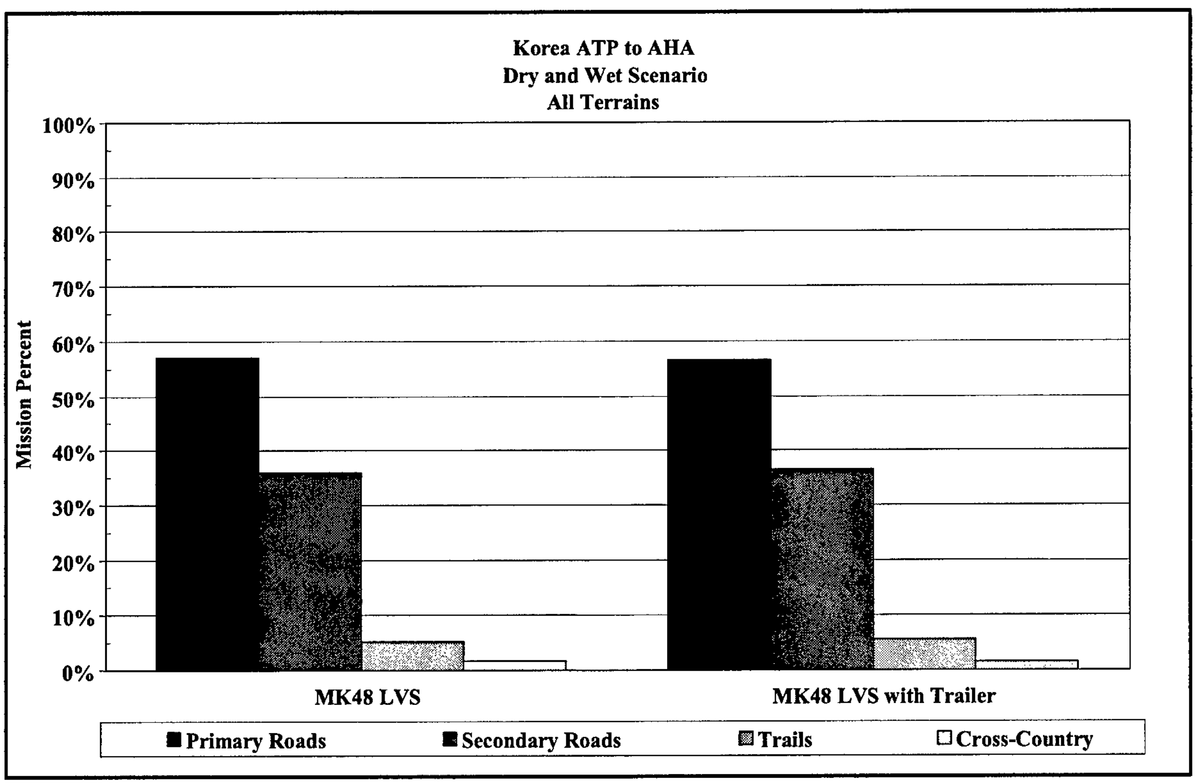


Figure C28. Terrains encountered by the MK48 vehicle operating from ATP to AHA in Korea

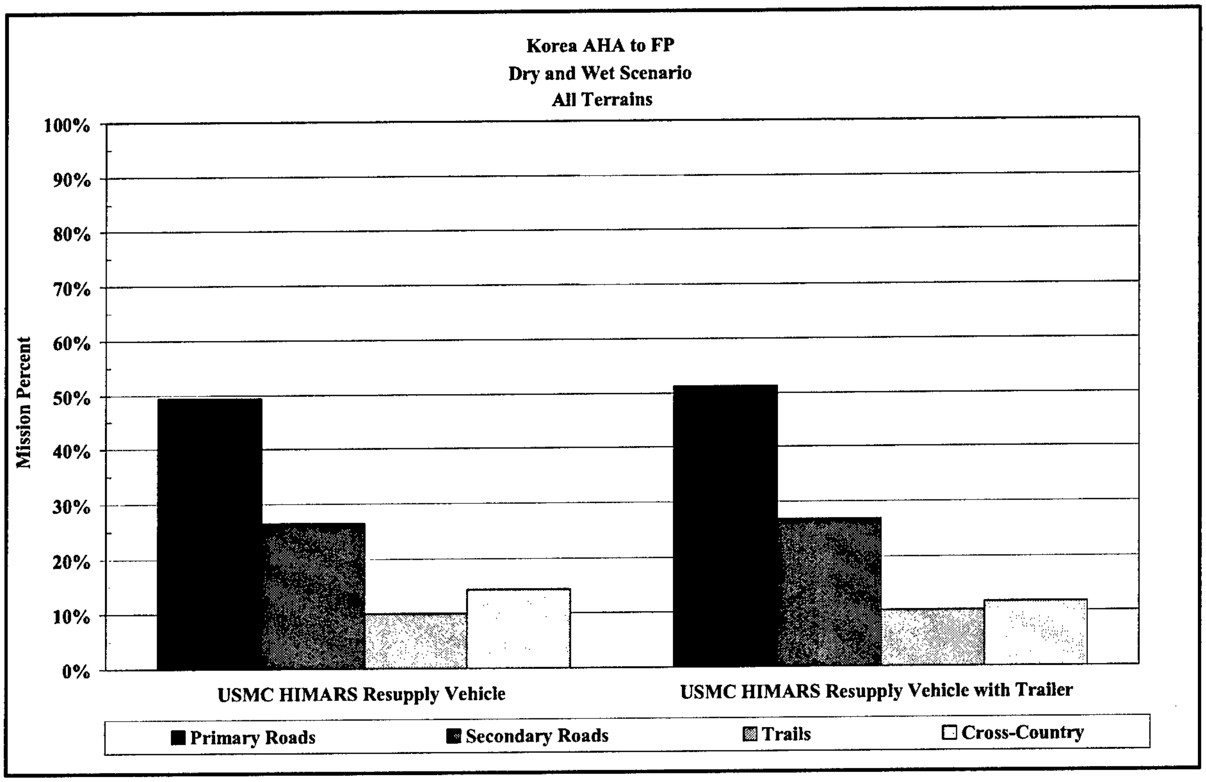


Figure C29. Terrains encountered by the HIMARS vehicle operating from AHA to FP in Korea

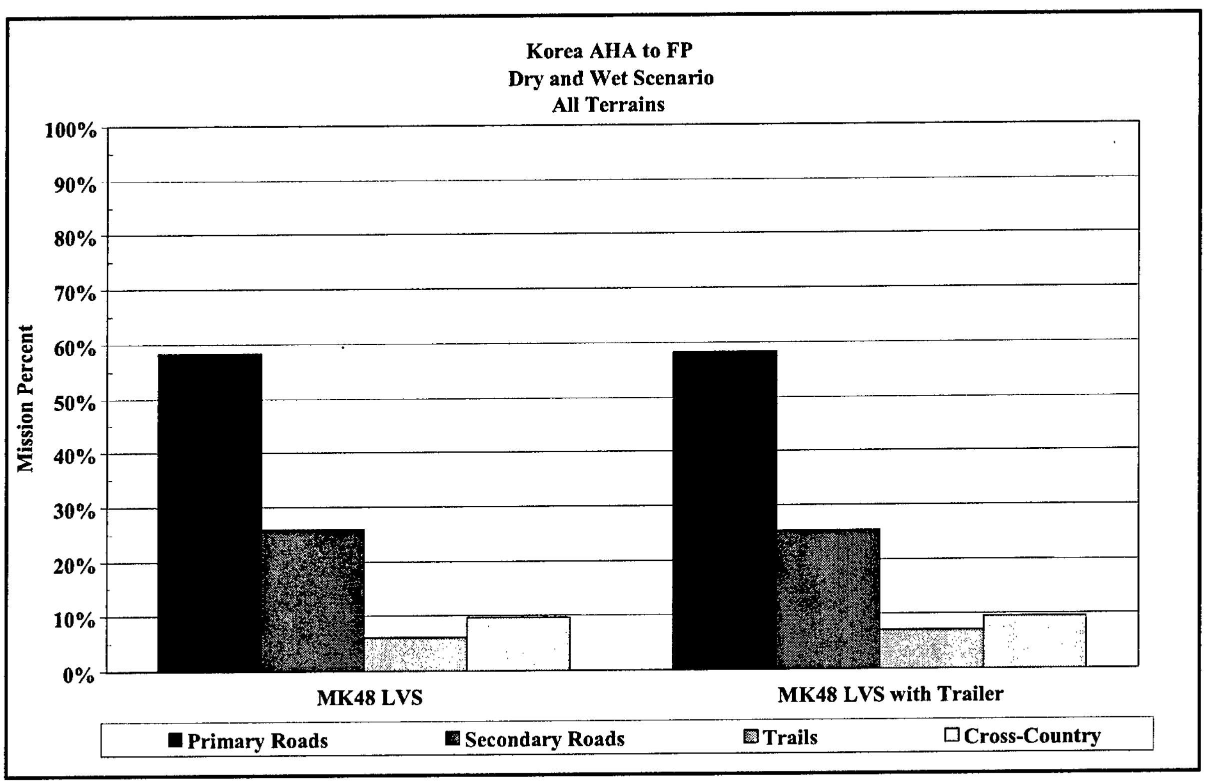


Figure C30. Terrains encountered by the MK48 vehicle operating from AHA to FP in Korea

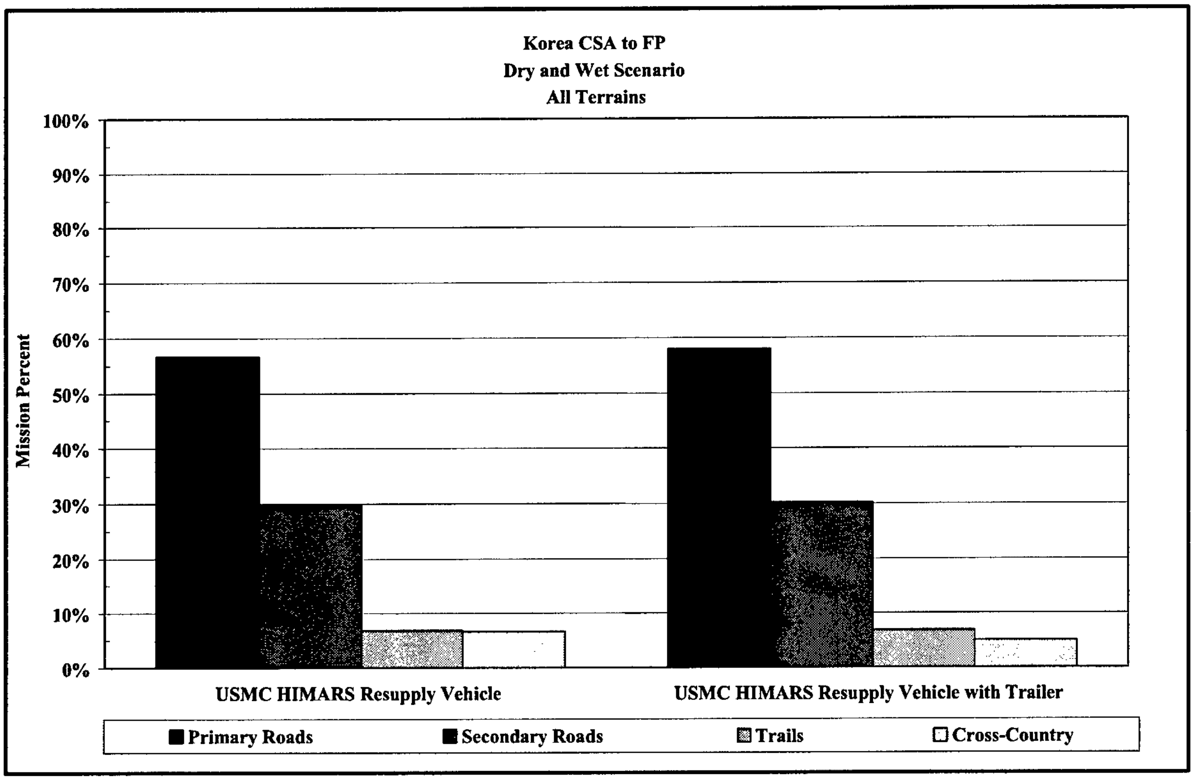


Figure C31. Terrains encountered by the HIMARS vehicle operating from CSA to FP in Korea

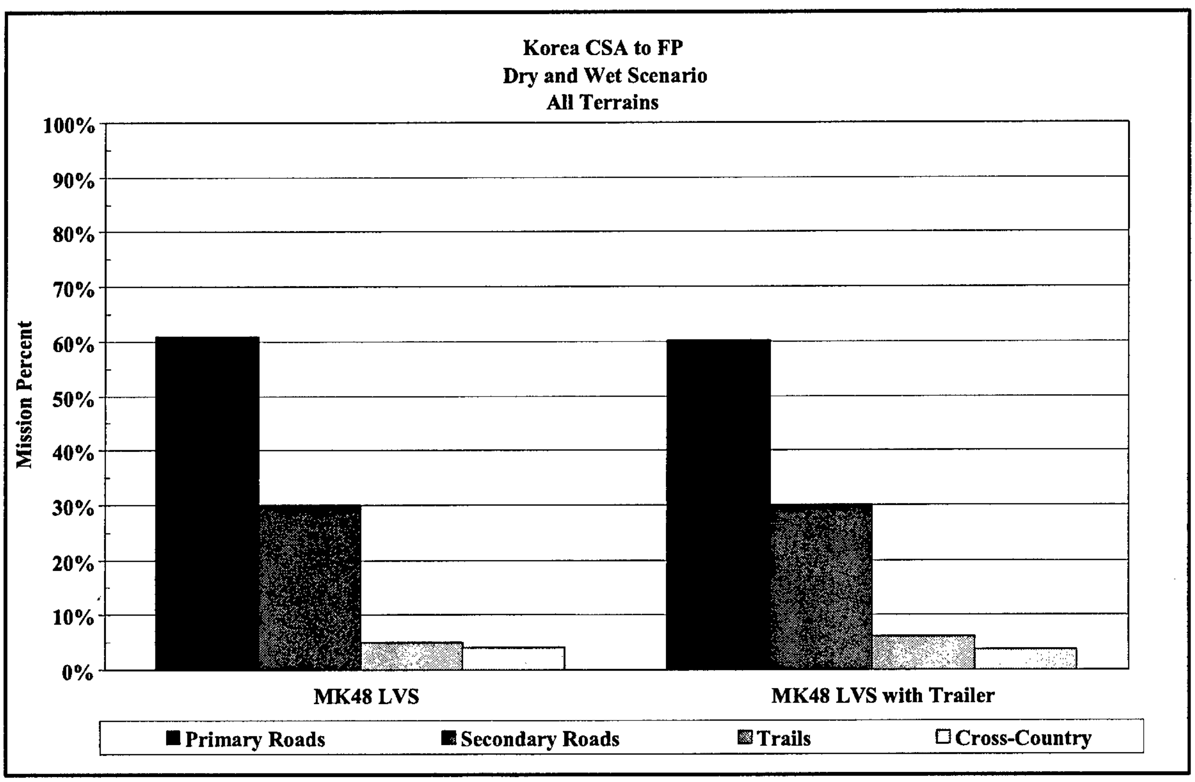


Figure C32. Terrains encountered by the MK48 vehicle operating from CSA to FP in Korea

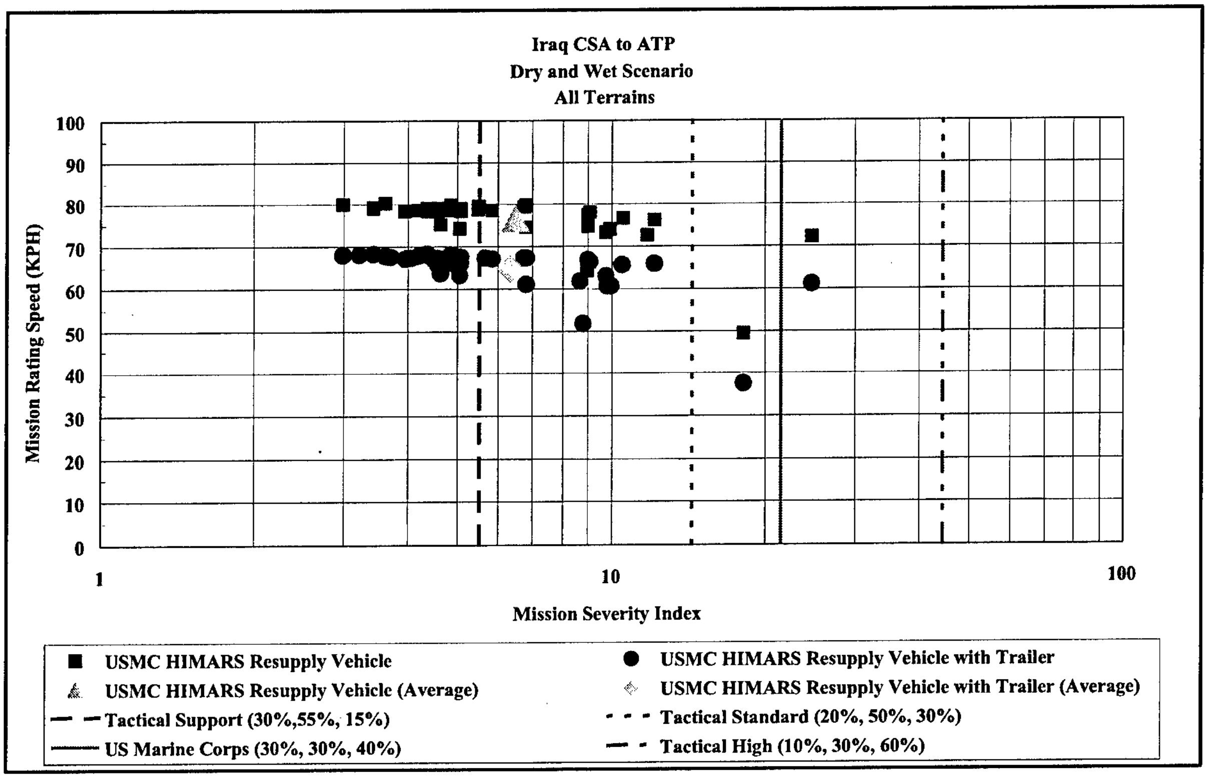


Figure C33. Performance chart for the HIMARS vehicle operating from CSA to ATP in Iraq

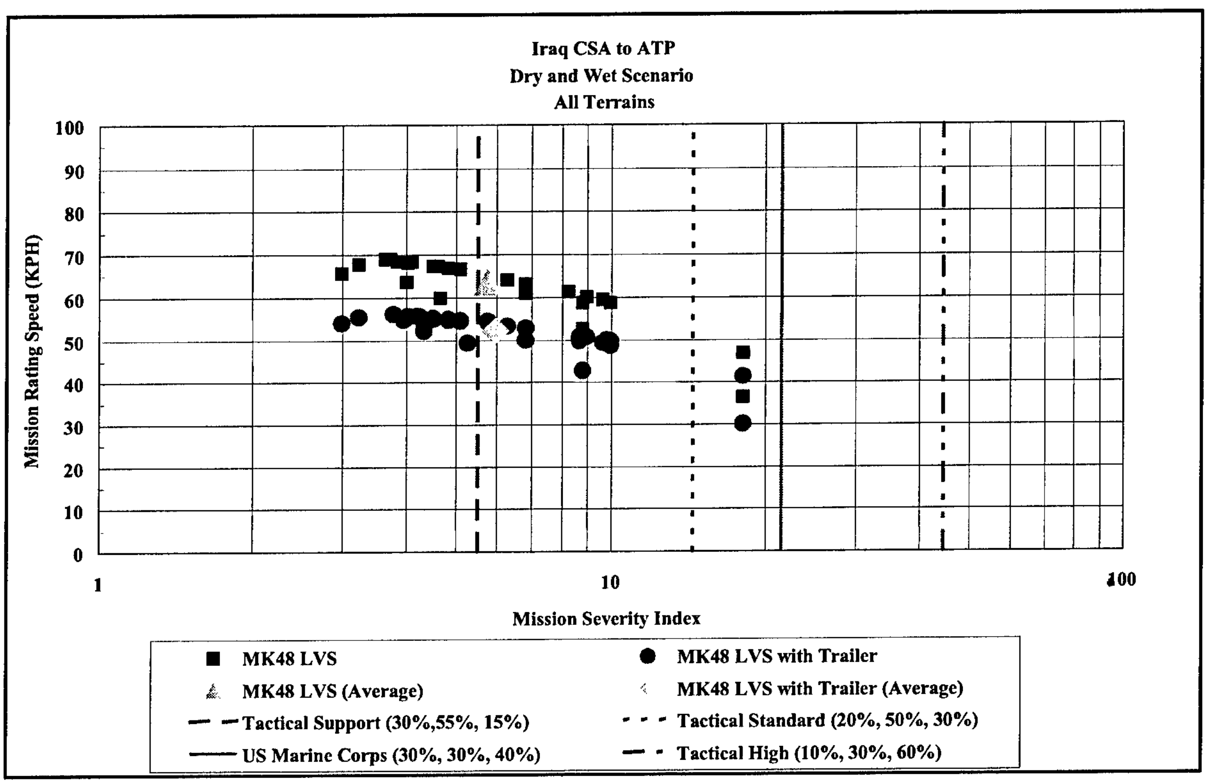


Figure C34. Performance chart for the MK48 vehicle operating from CSA to ATP in Iraq

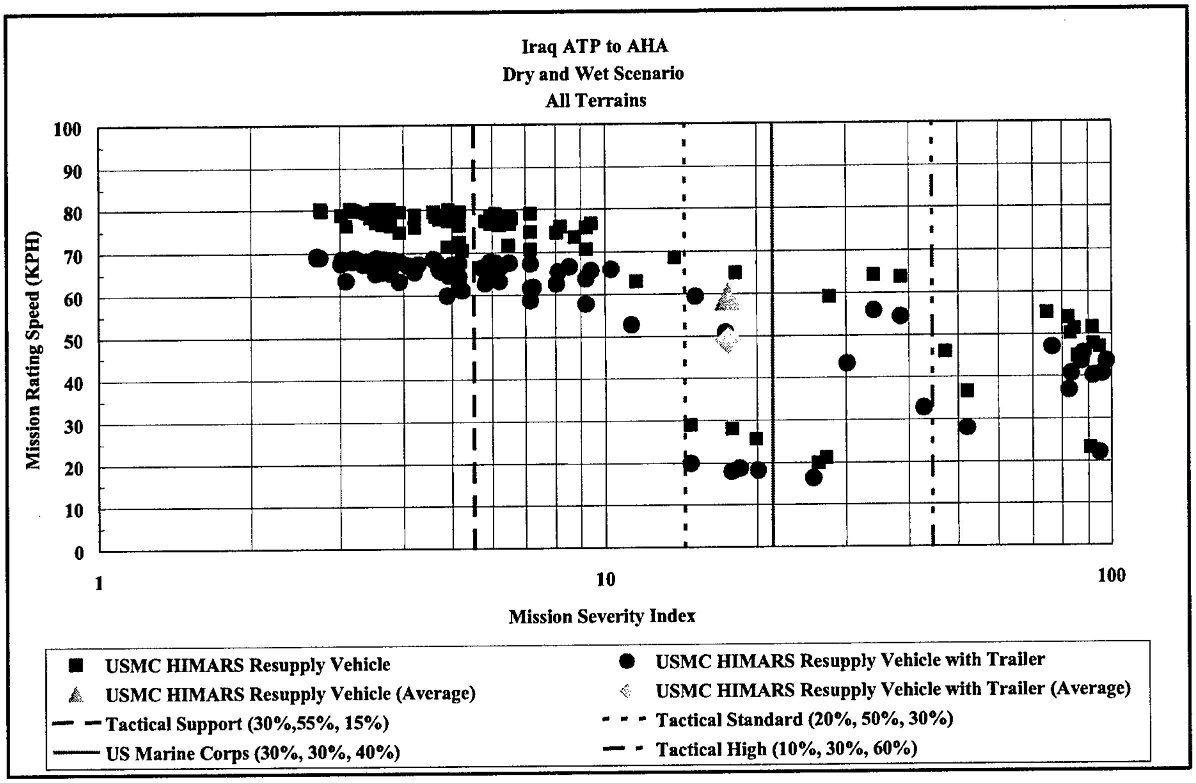


Figure C35. Performance chart for the HIMARS vehicle operating from ATP to AHA in Iraq

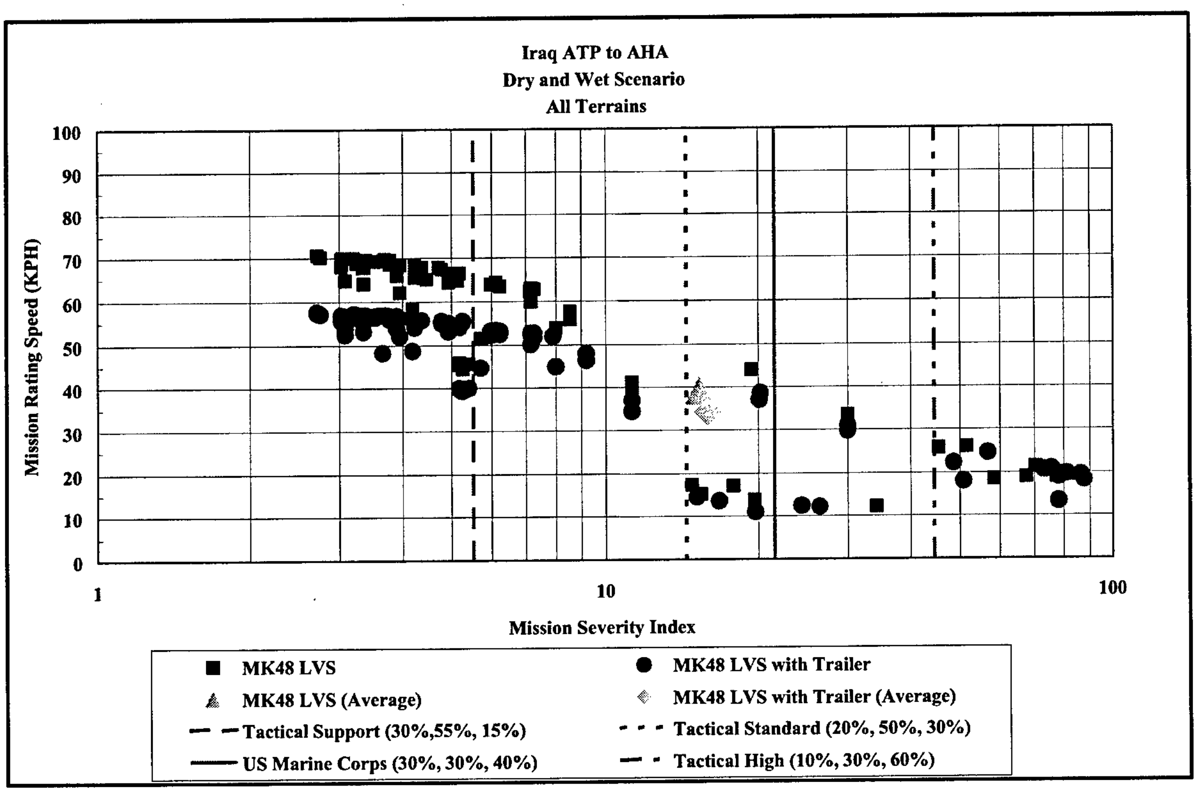


Figure C36. Performance chart for the MK48 vehicle operating from ATP to AHA in Iraq

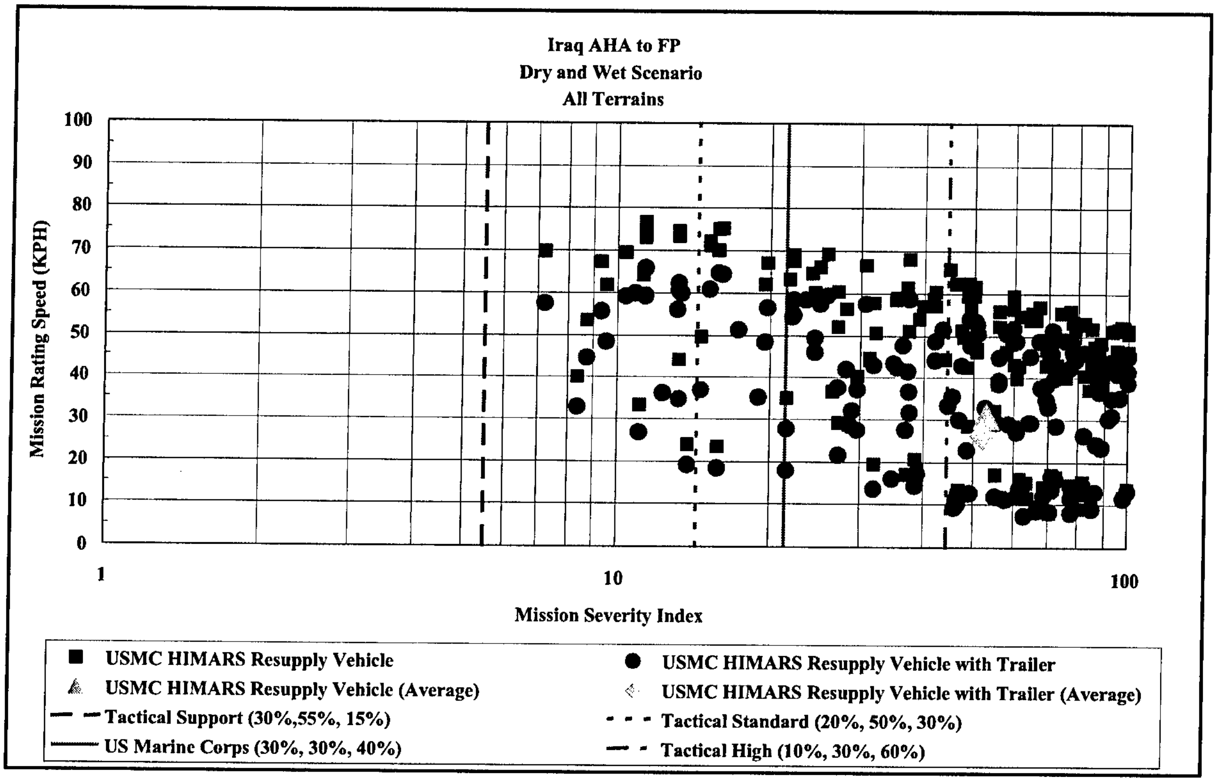


Figure C37. Performance chart for the HIMARS vehicle operating from AHA to FP in Iraq

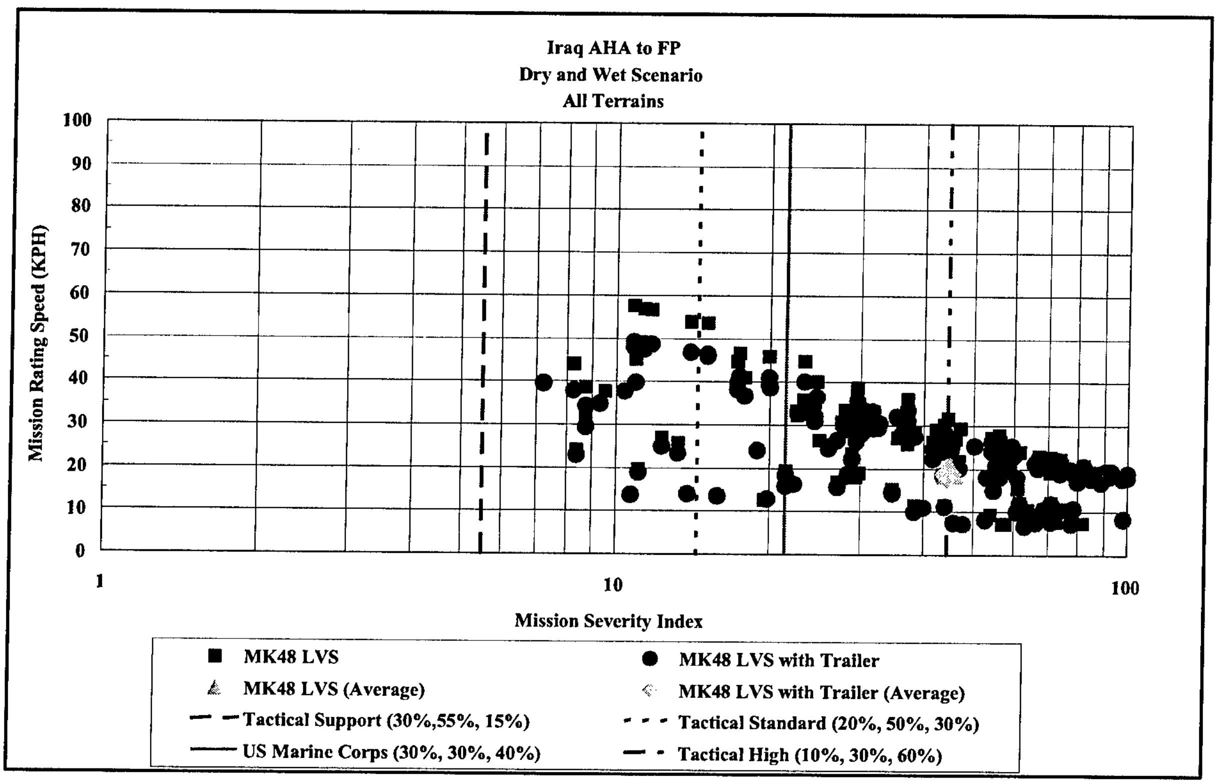


Figure C38. Performance chart for the MK48 vehicle operating from AHA to FP in Iraq

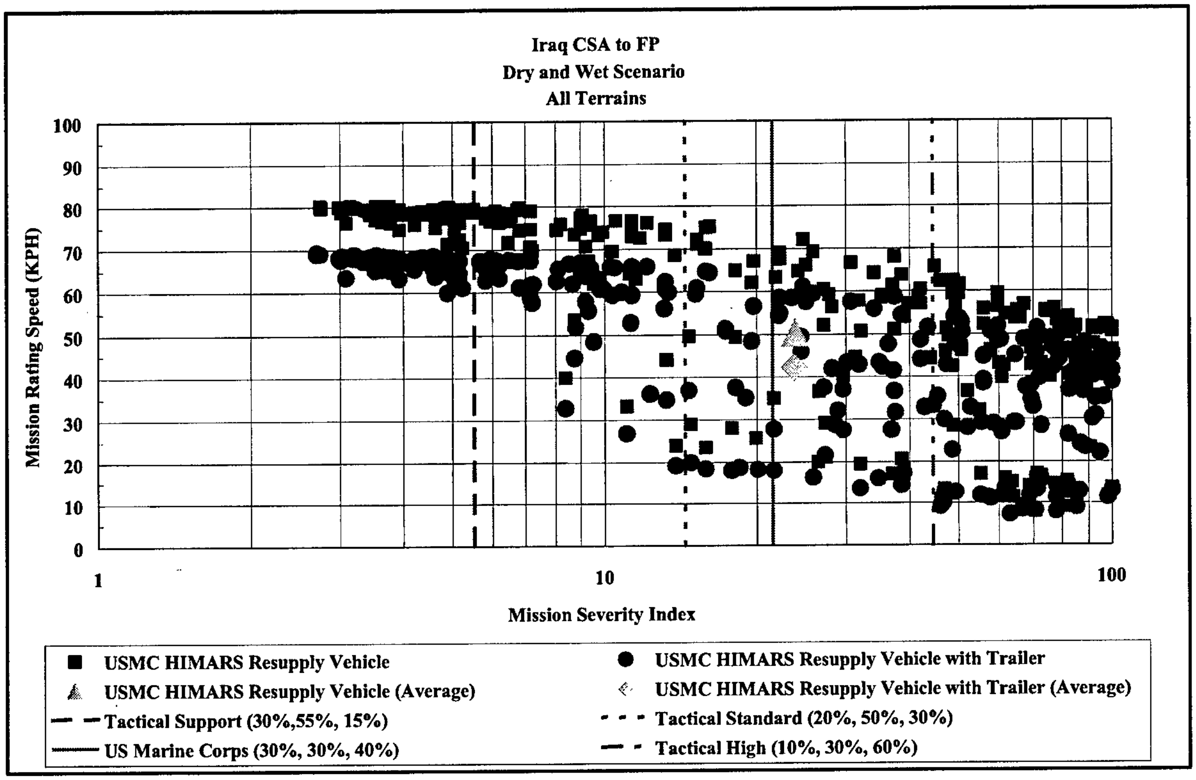


Figure C39. Performance chart for the HIMARS vehicle operating from CSA to FP in Iraq

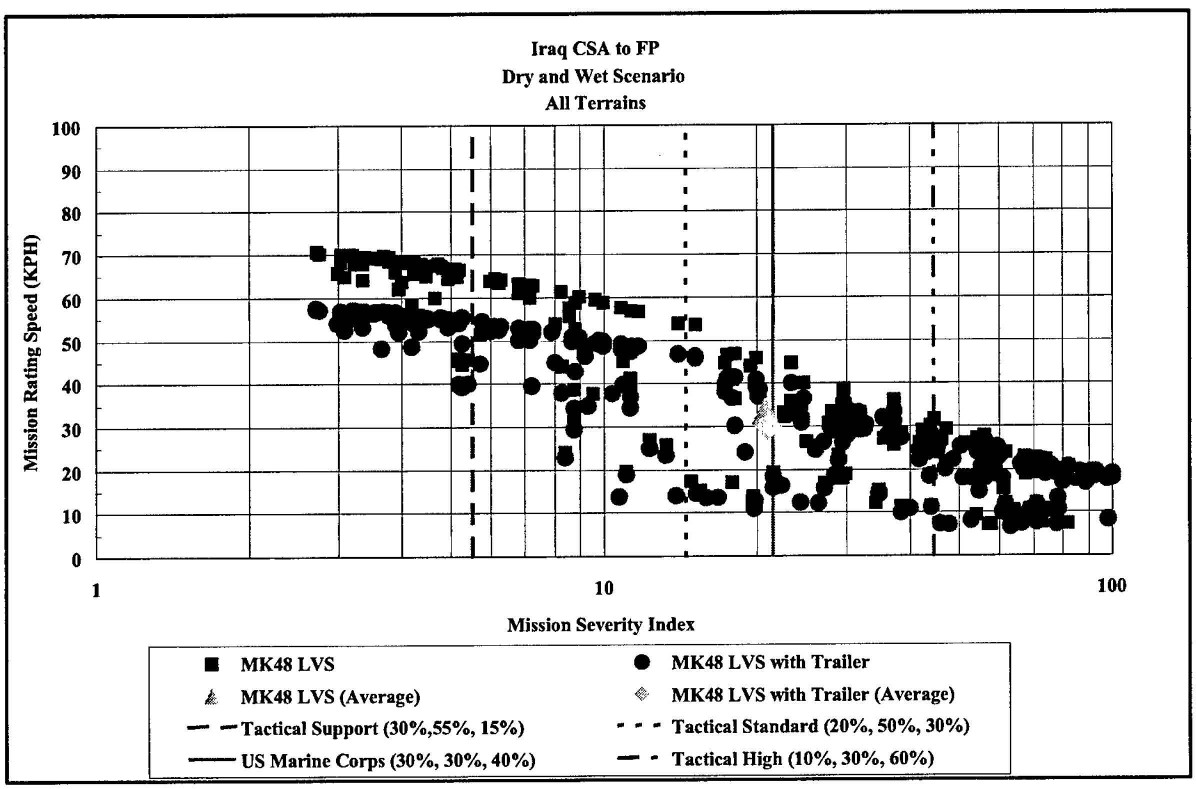


Figure C40. Performance chart for the MK48 vehicle operating from CSA to FP in Iraq

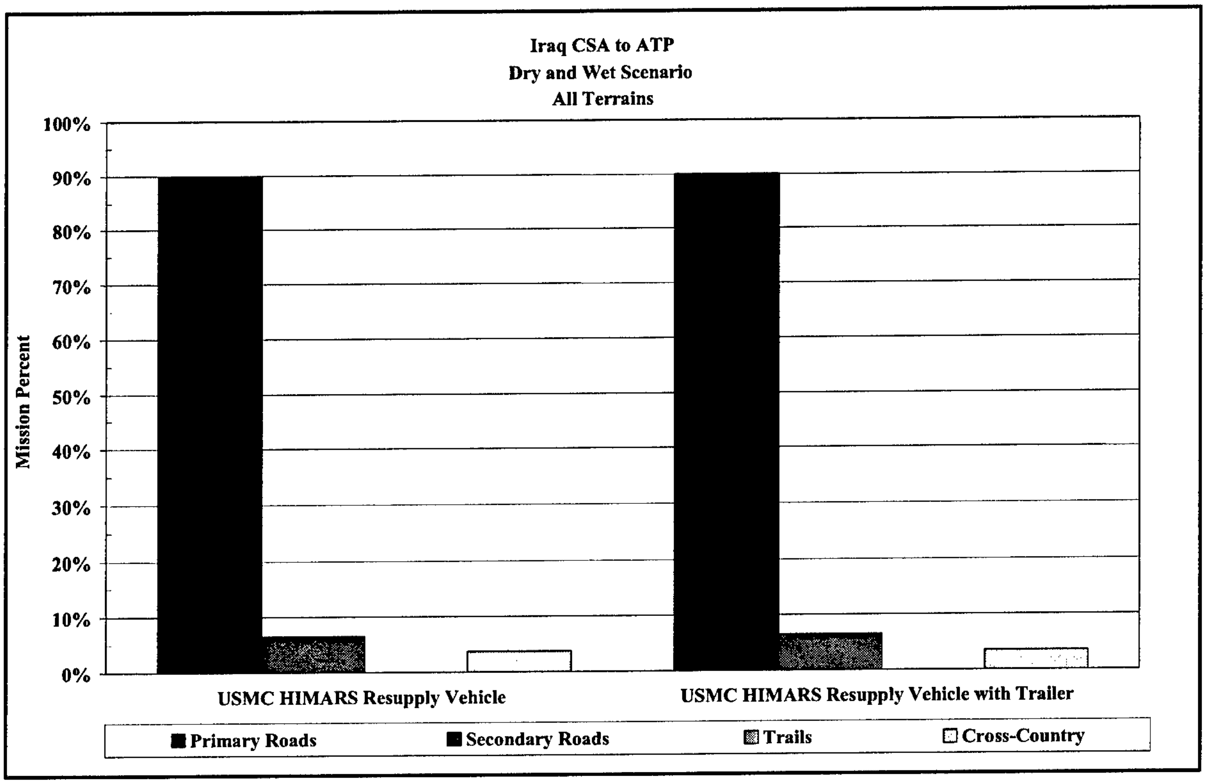


Figure C41. Terrains encountered by the HIMARS vehicle operating from CSA to ATP in Iraq

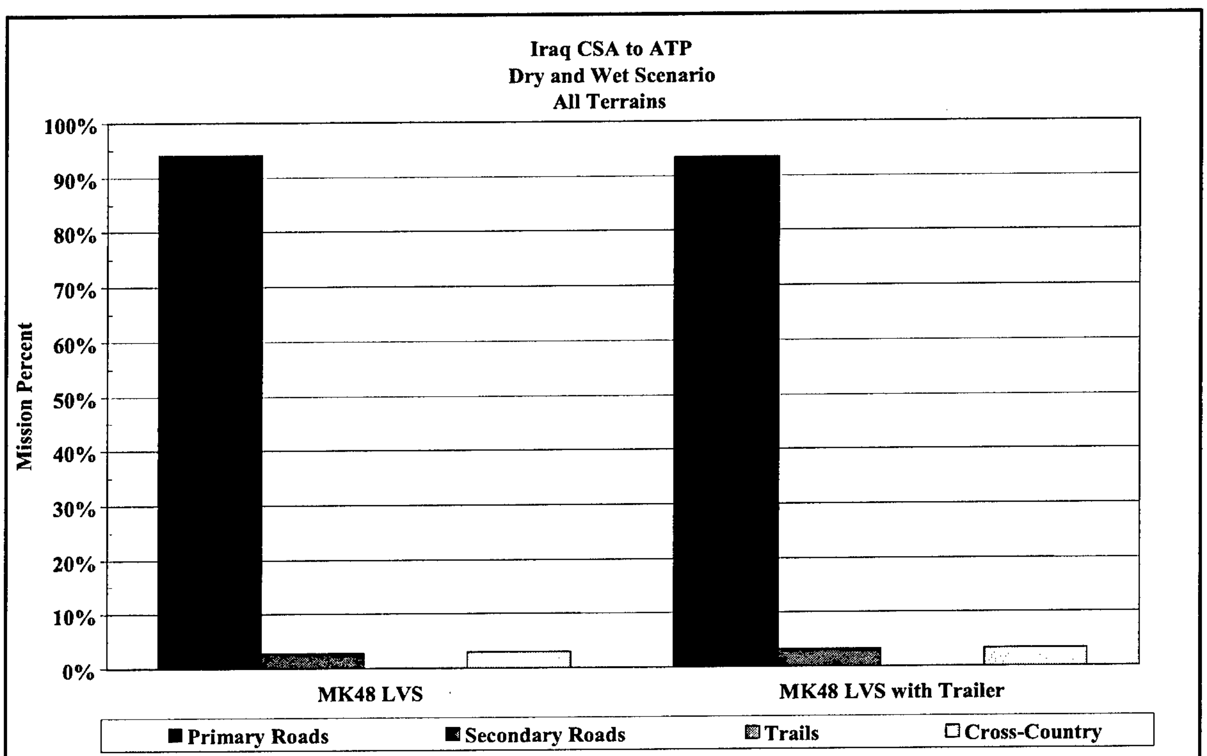


Figure C42. Terrains encountered by the MK48 vehicle operating from CSA to ATP in Iraq

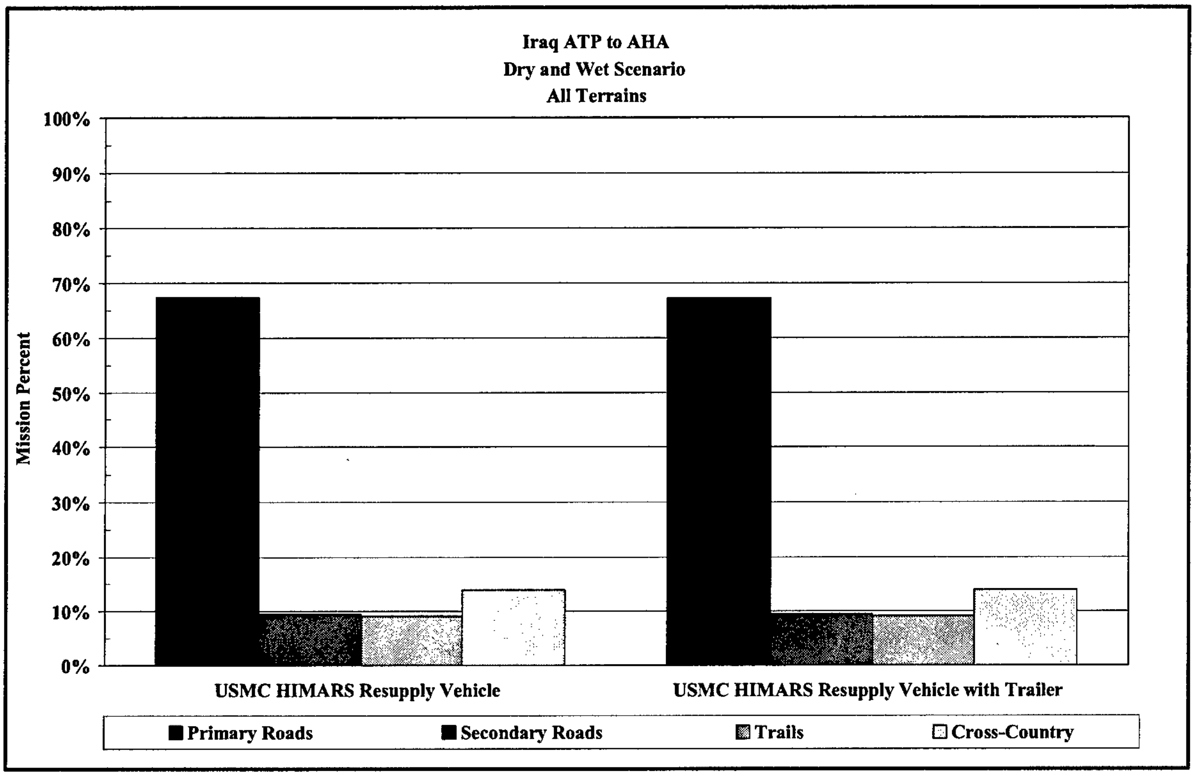


Figure C43. Terrains encountered by the HIMARS vehicle operating from ATP to AHA in Iraq

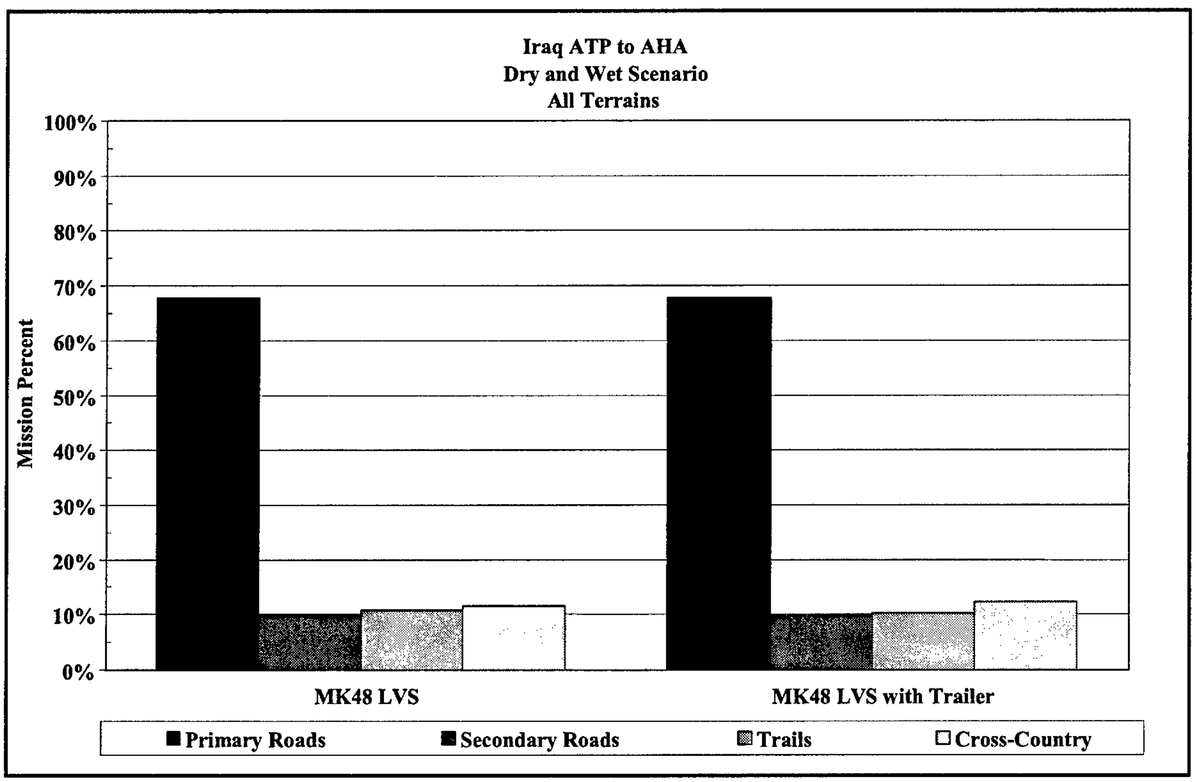


Figure C44. Terrains encountered by the MK48 vehicle operating from ATP to AHA in Iraq

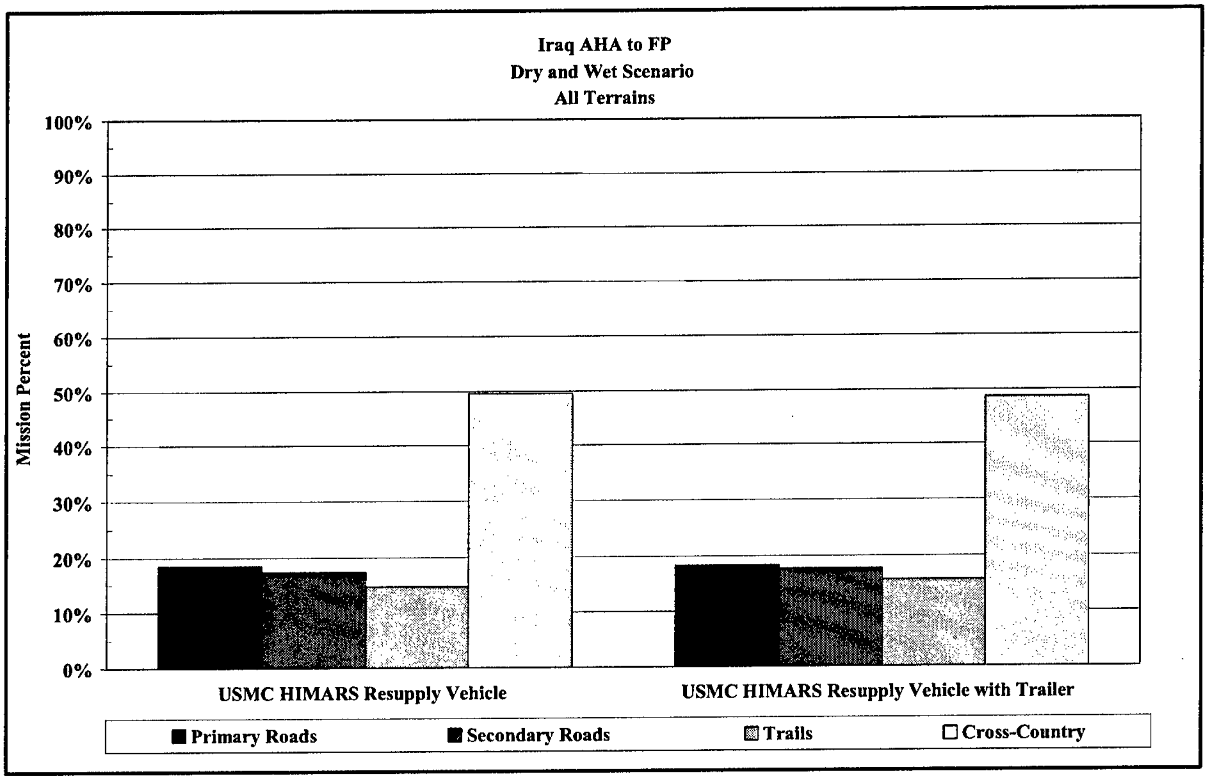
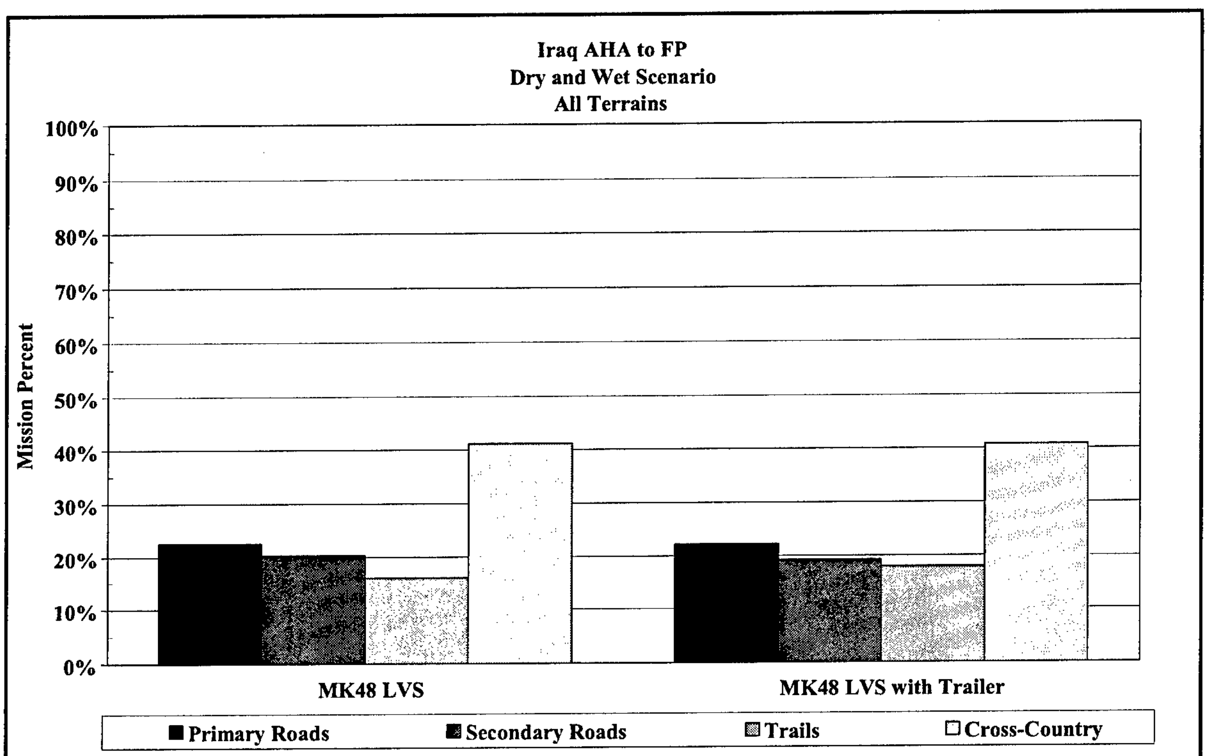


Figure C45. Terrains encountered by the HIMARS vehicle operating from AHA to FP in Iraq



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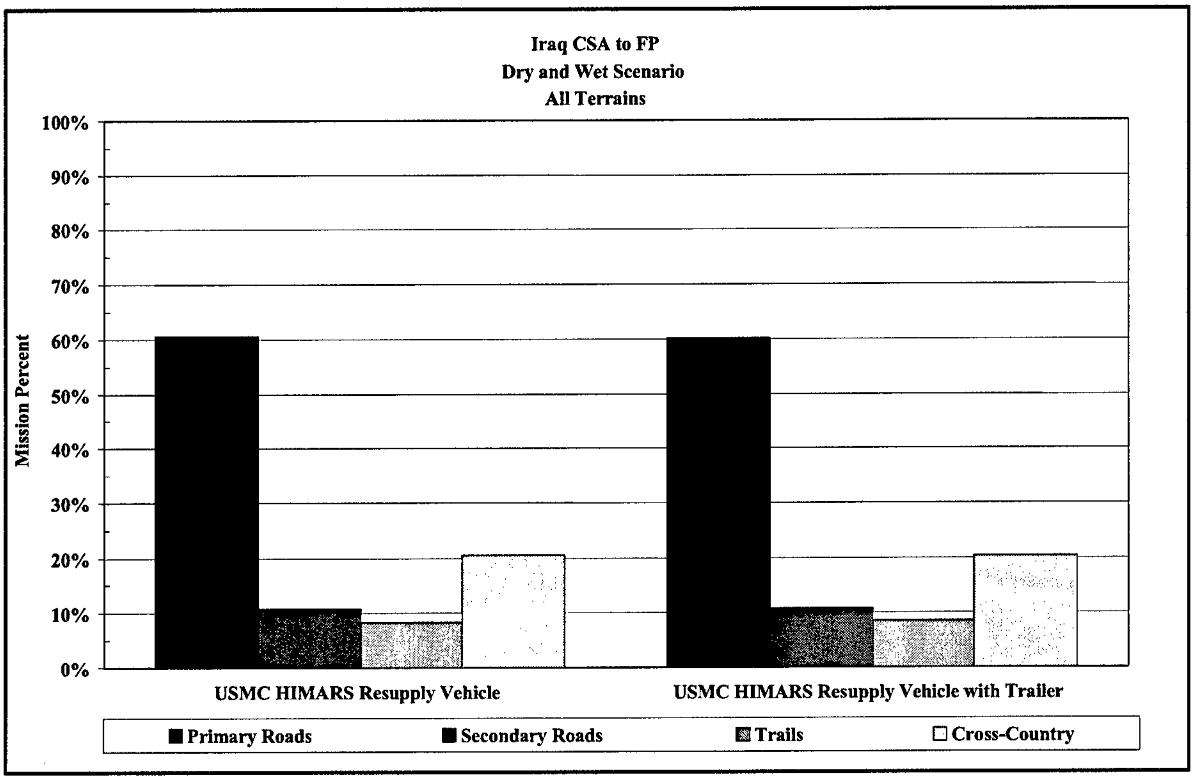

Figure C47. Terrains encountered by the HIMARS vehicle operating from CSA to FP in Iraq

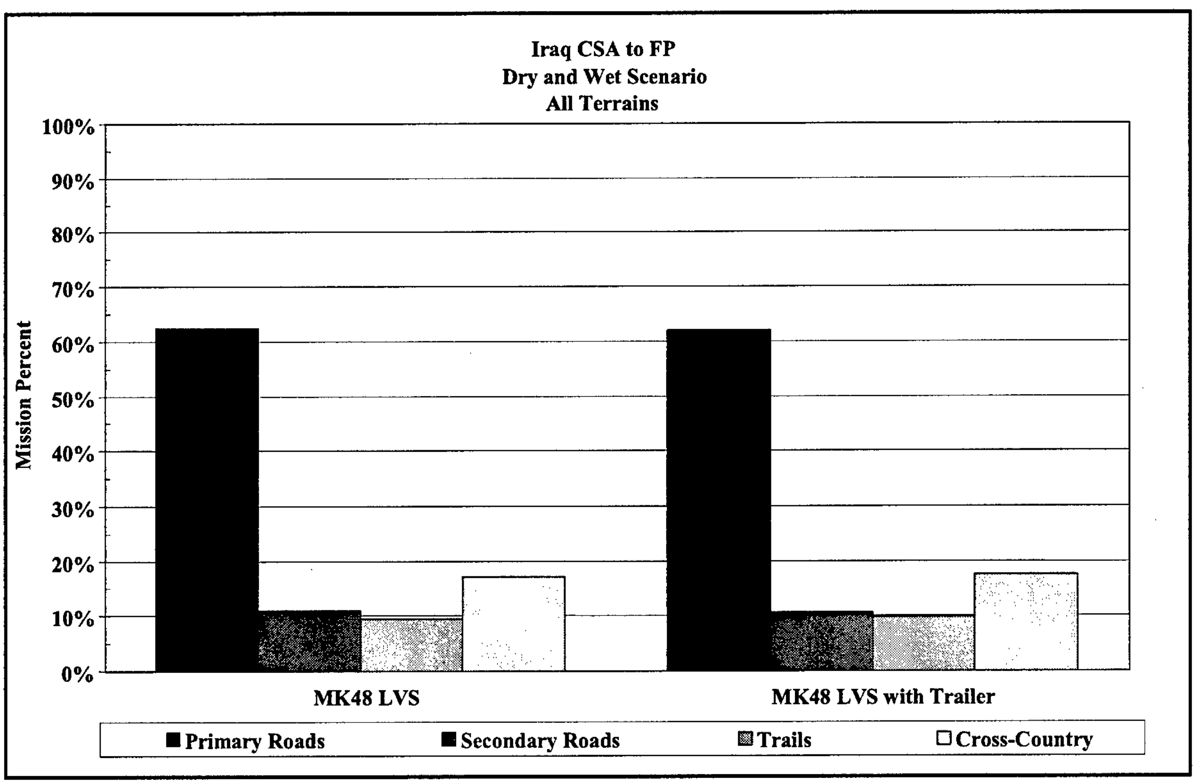

Figure C48. Terrains encountered by the MK48 vehicle operating from CSA to FP in Iraq

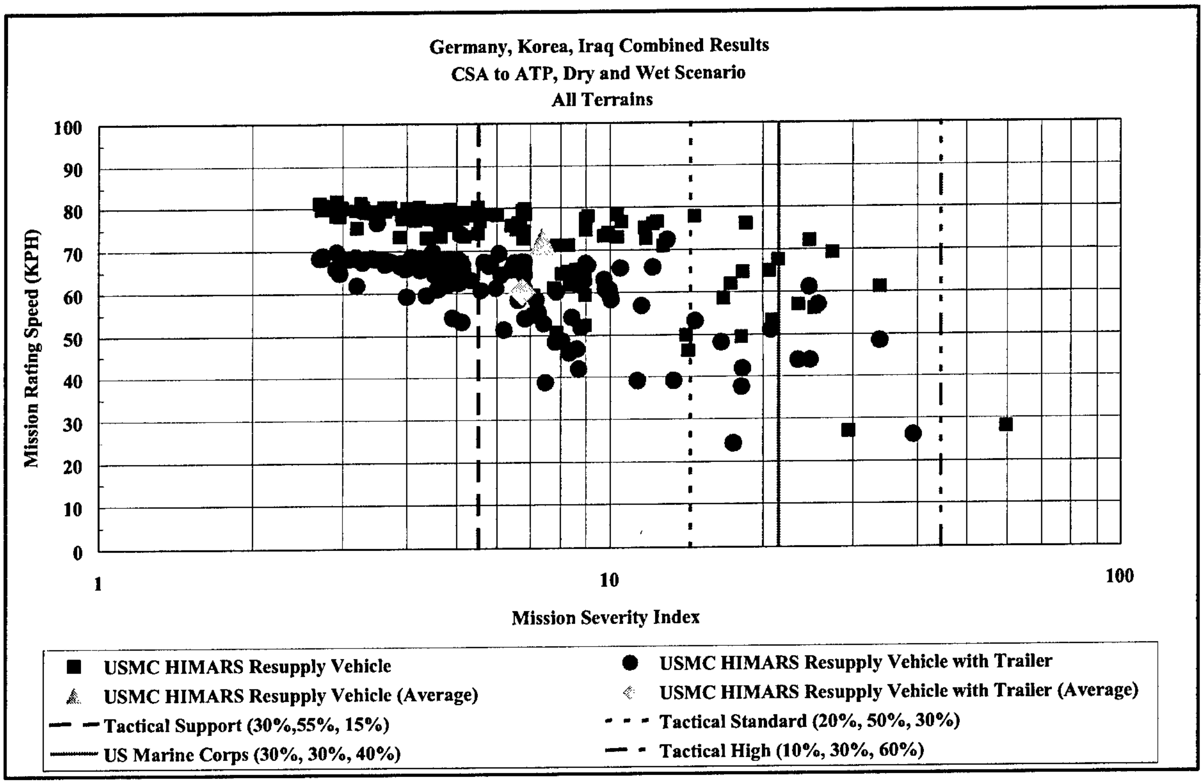

Figure C49. Combined performance chart for the HIMARS vehicle operating from CSA to ATP

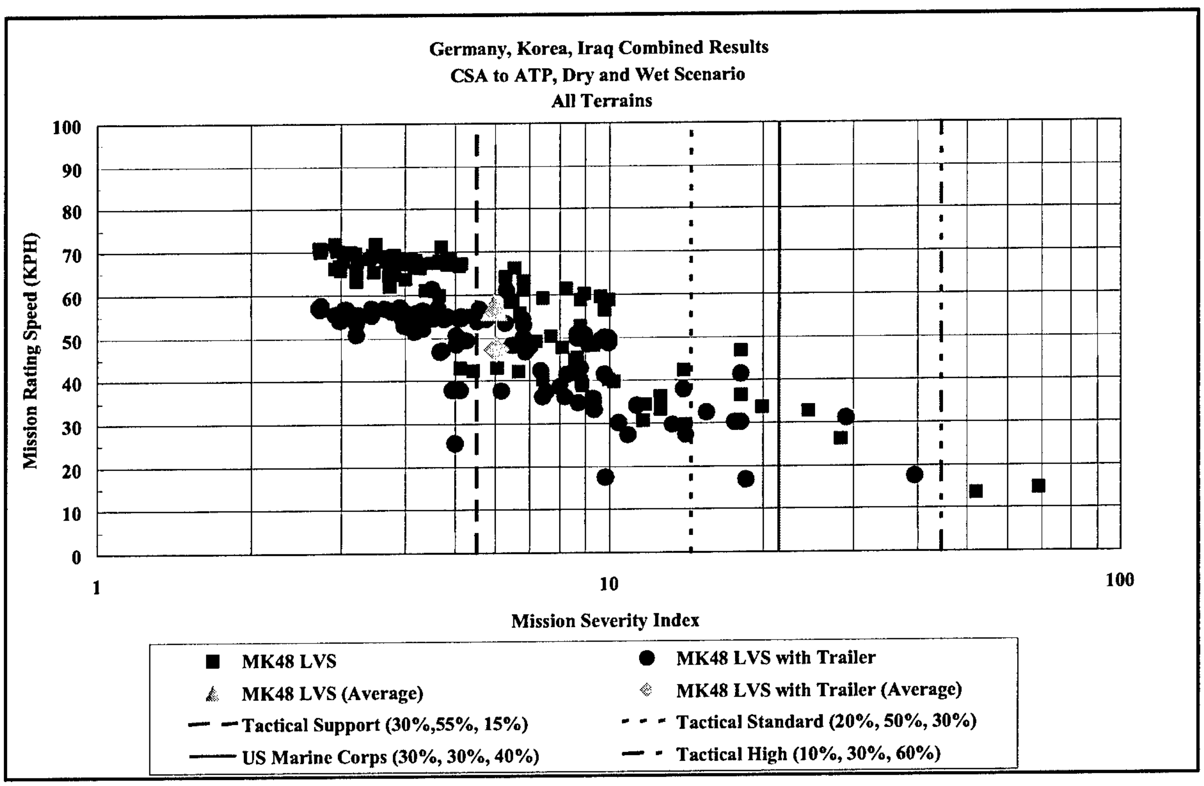

Figure C50. Combined performance chart for the MK48 vehicle operating from CSA to ATP

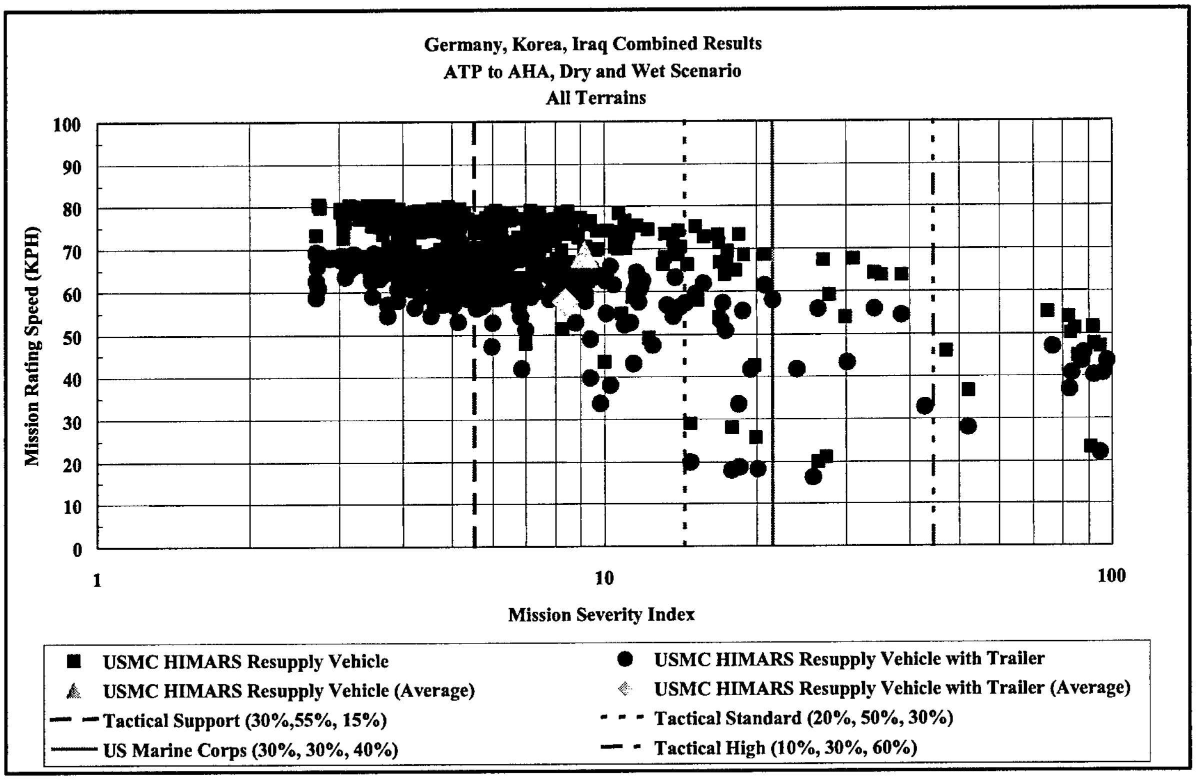

Figure C51. Combined performance chart for the HIMARS vehicle operating from ATP to AHA

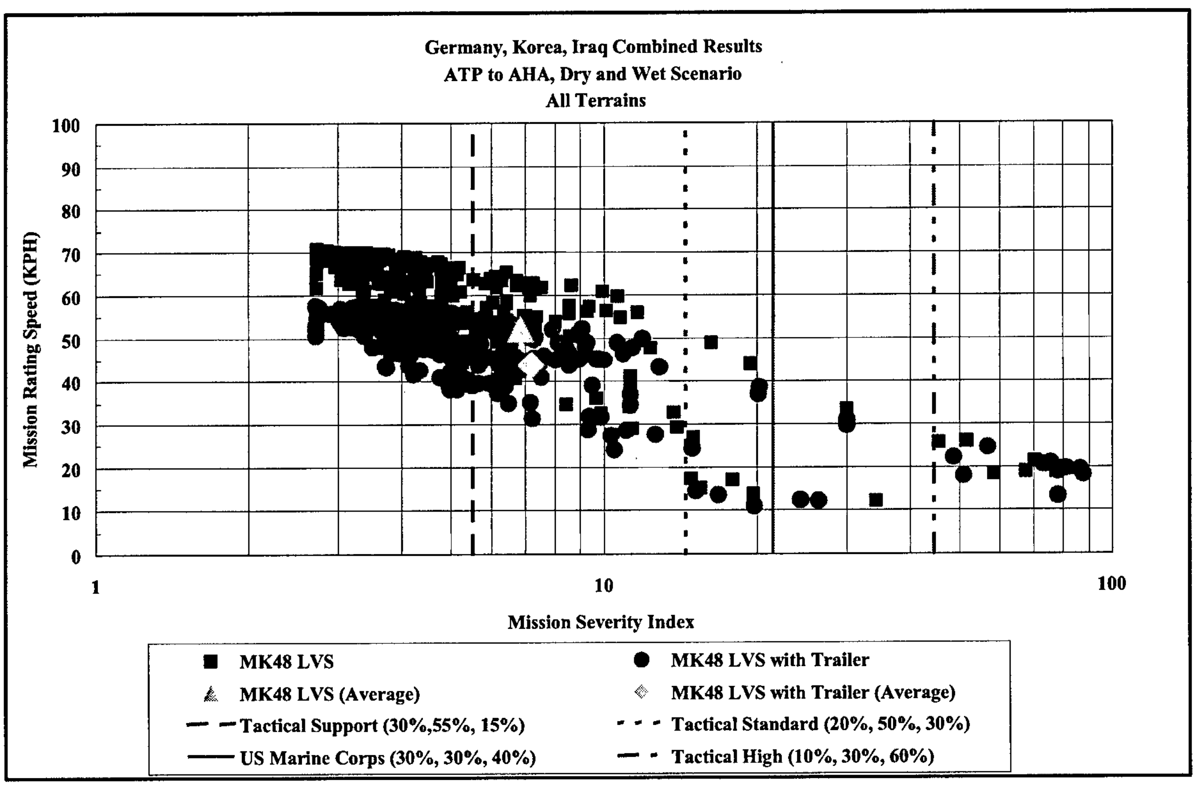

Figure C52. Combined performance chart for the MK48 vehicle operating from ATP to AHA

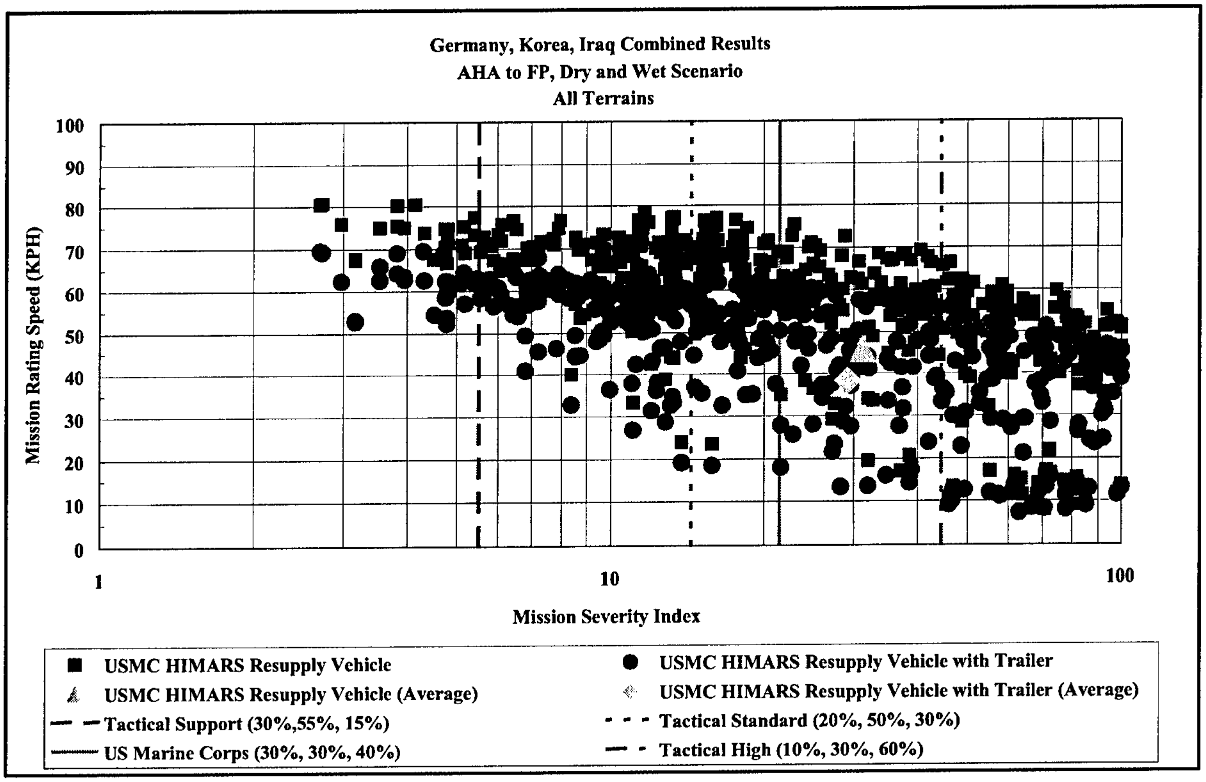

Figure C53. Combined performance chart for the HIMARS vehicle operating from AHA to FP

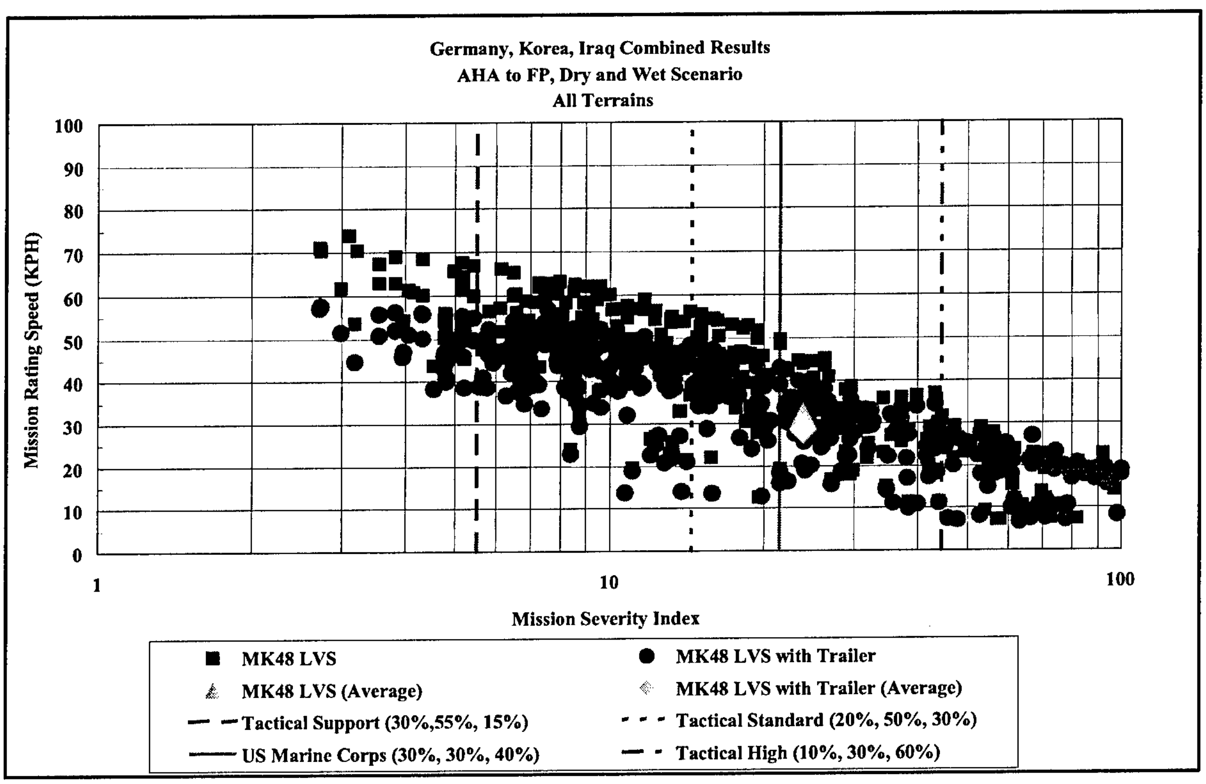

Figure C54. Combined performance chart for the MK48 vehicle operating from AHA to FP

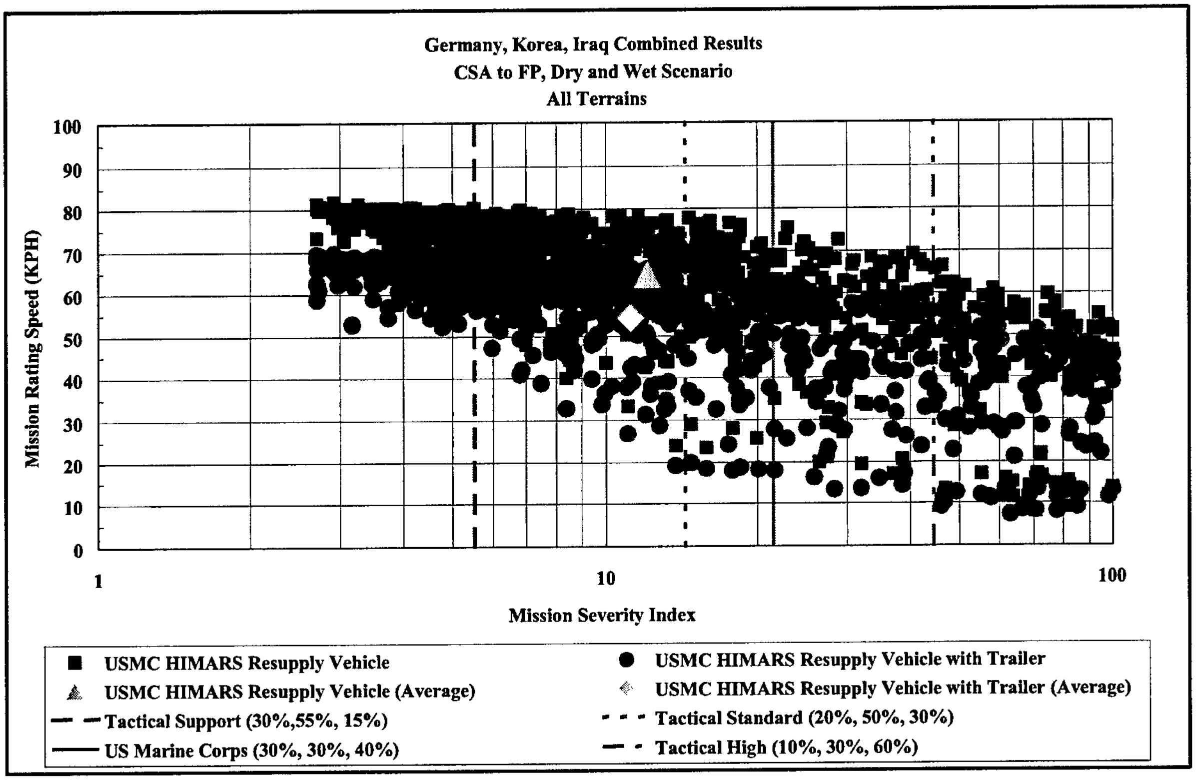

Figure C55. Combined performance chart for the HIMARS vehicle operating from CSA to FP

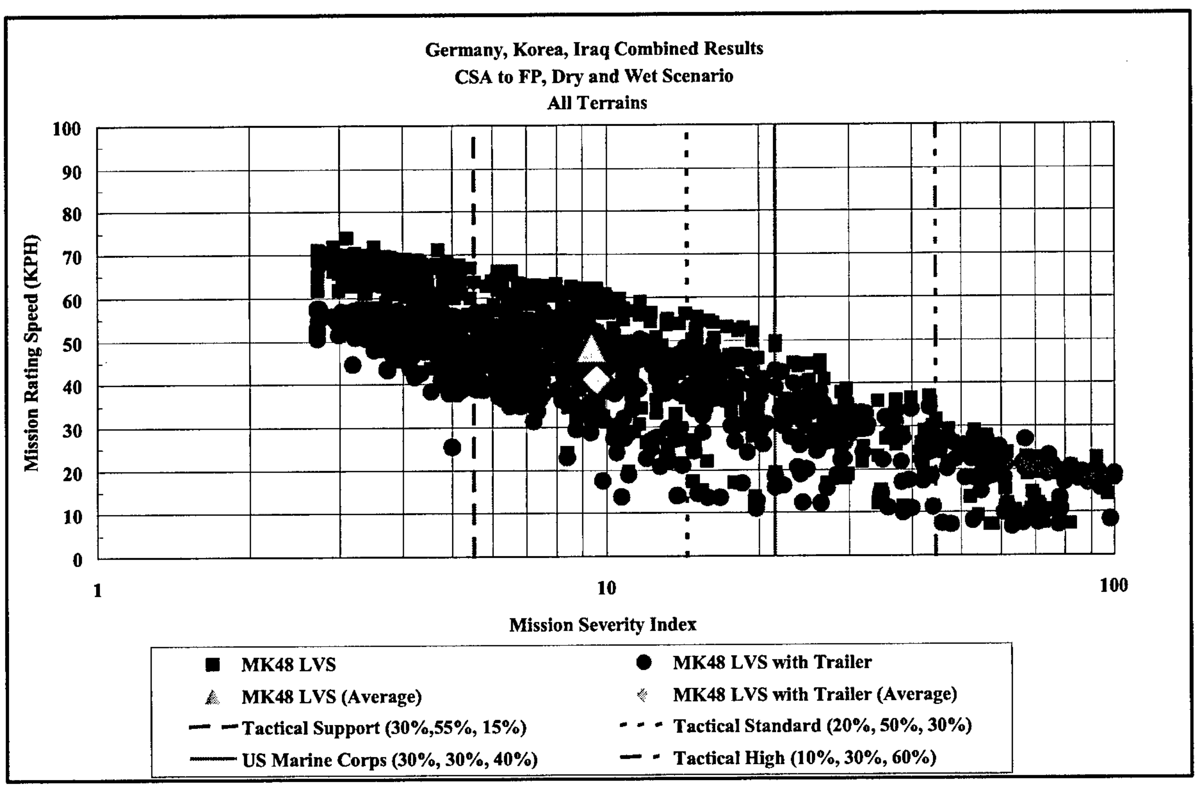

Figure C56. Combined performance chart for the MK48 vehicle operating from CSA to FP

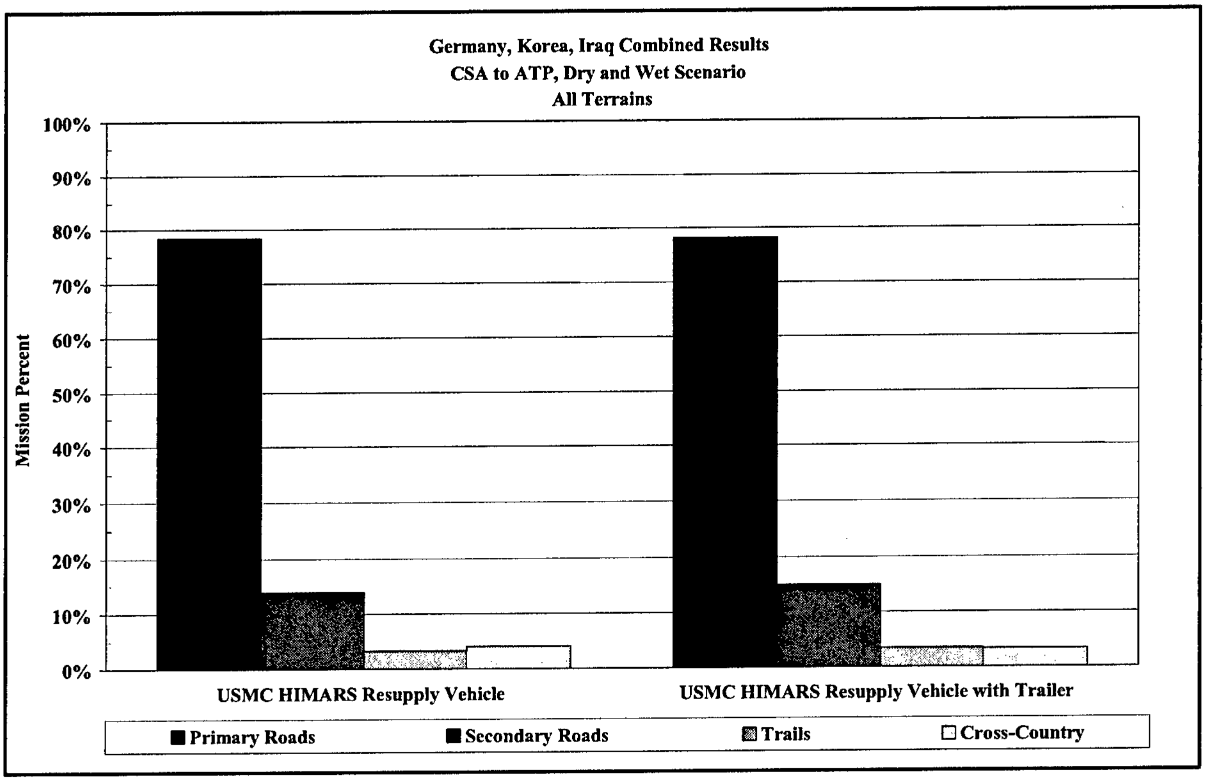

Figure C57. Combined area terrains encountered by the HIMARS vehicle operating from CSA to ATP

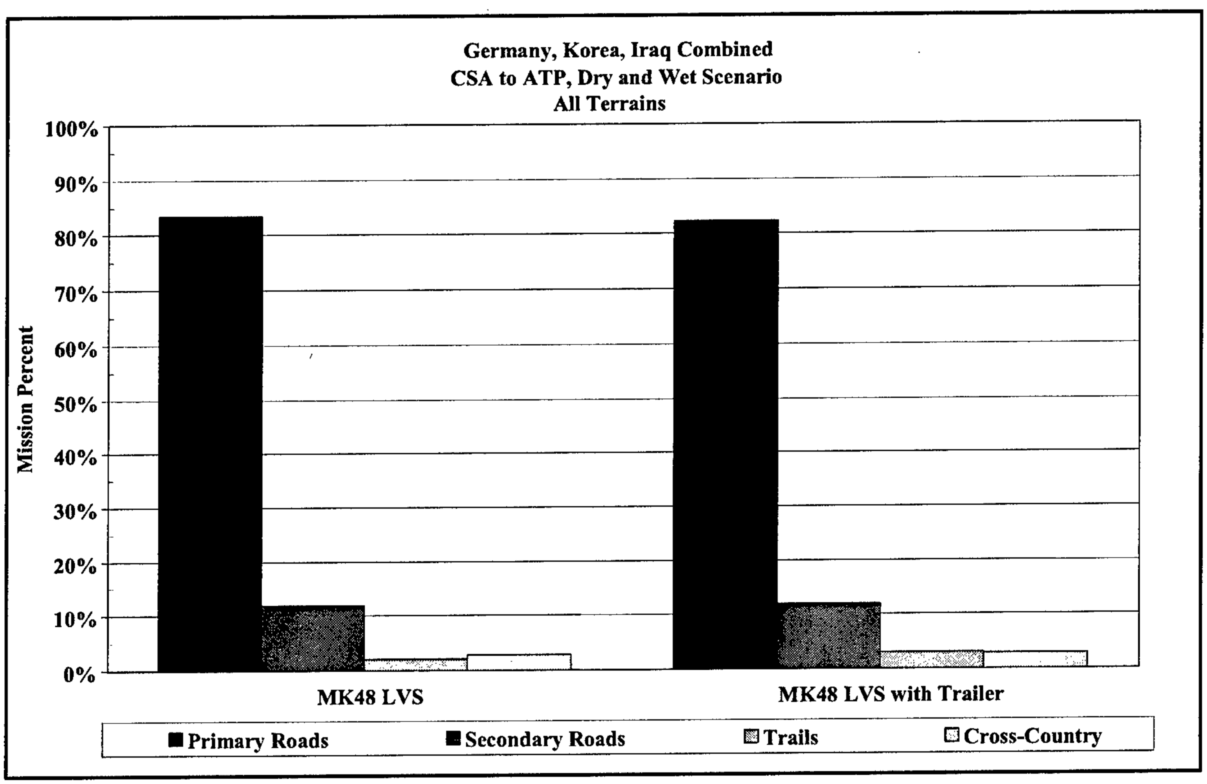

Figure C58. Combined area terrains encountered by the MK48 vehicle operating from CSA to ATP

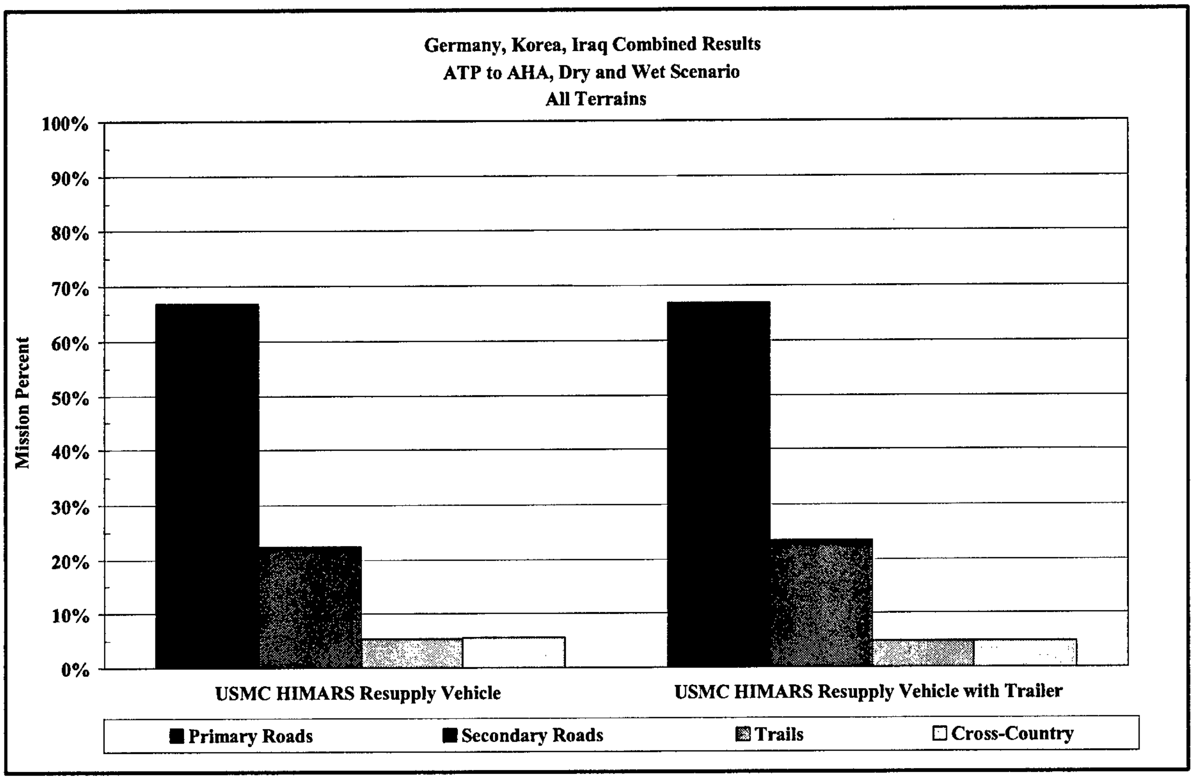

Figure C59. Combined areas terrains encountered by the HIMARS vehicle operating from ATP to AHA

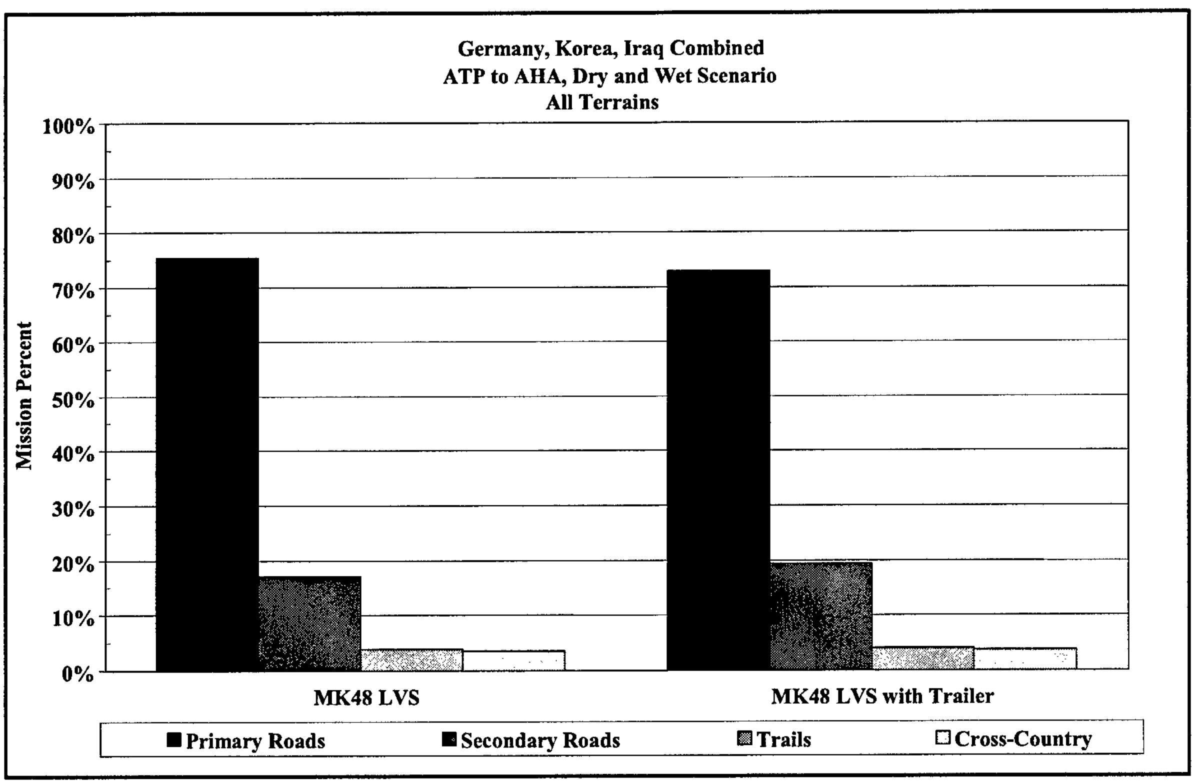

Figure C60. Combined area terrains encountered by the MK48 vehicle operating from ATP to AHA

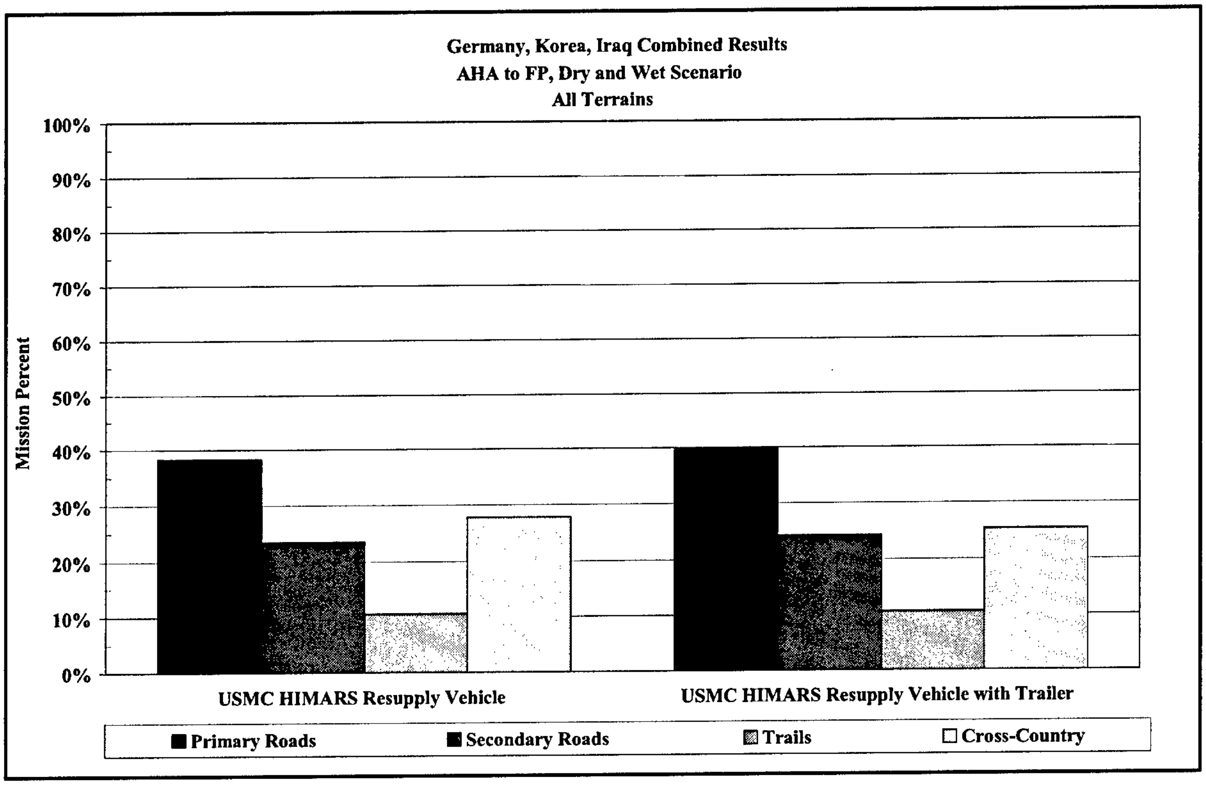

Figure C61. Combined area terrains encountered by the HIMARS vehicle operating from AHA to FP

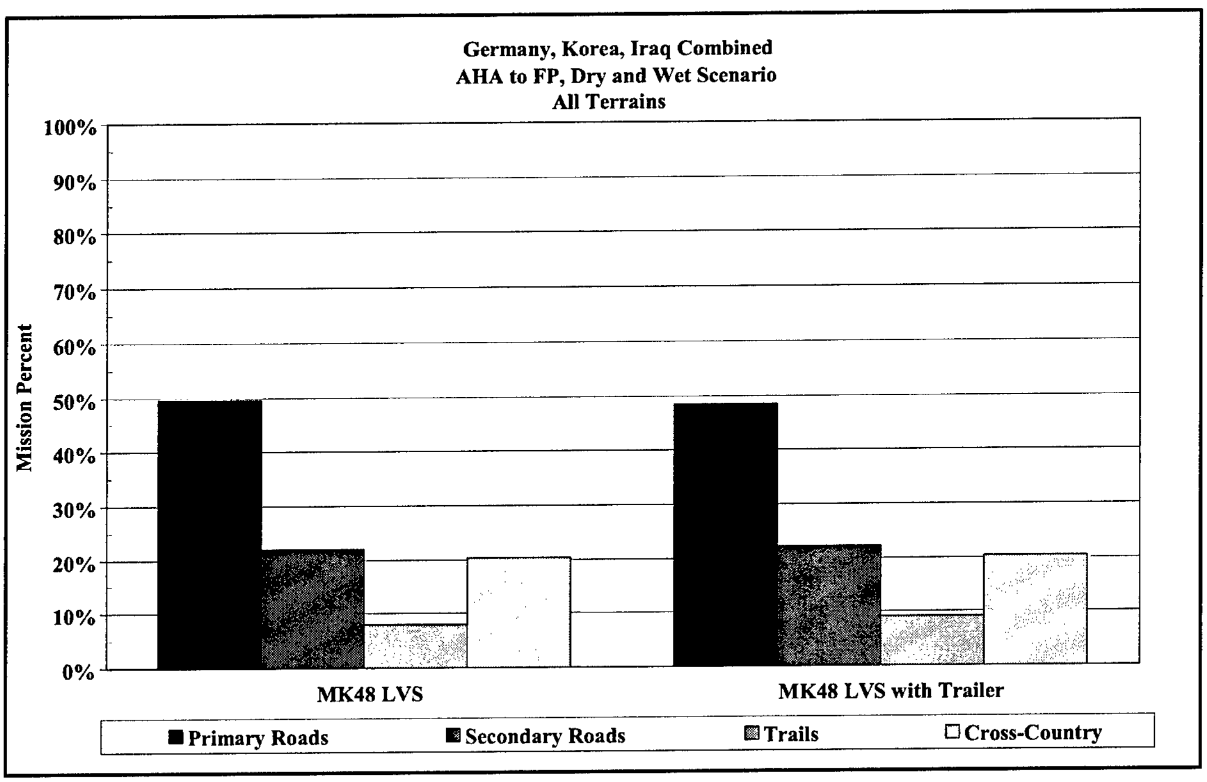

Figure C62. Combined area terrains encountered by the MK48 vehicle operating from AHA to FP

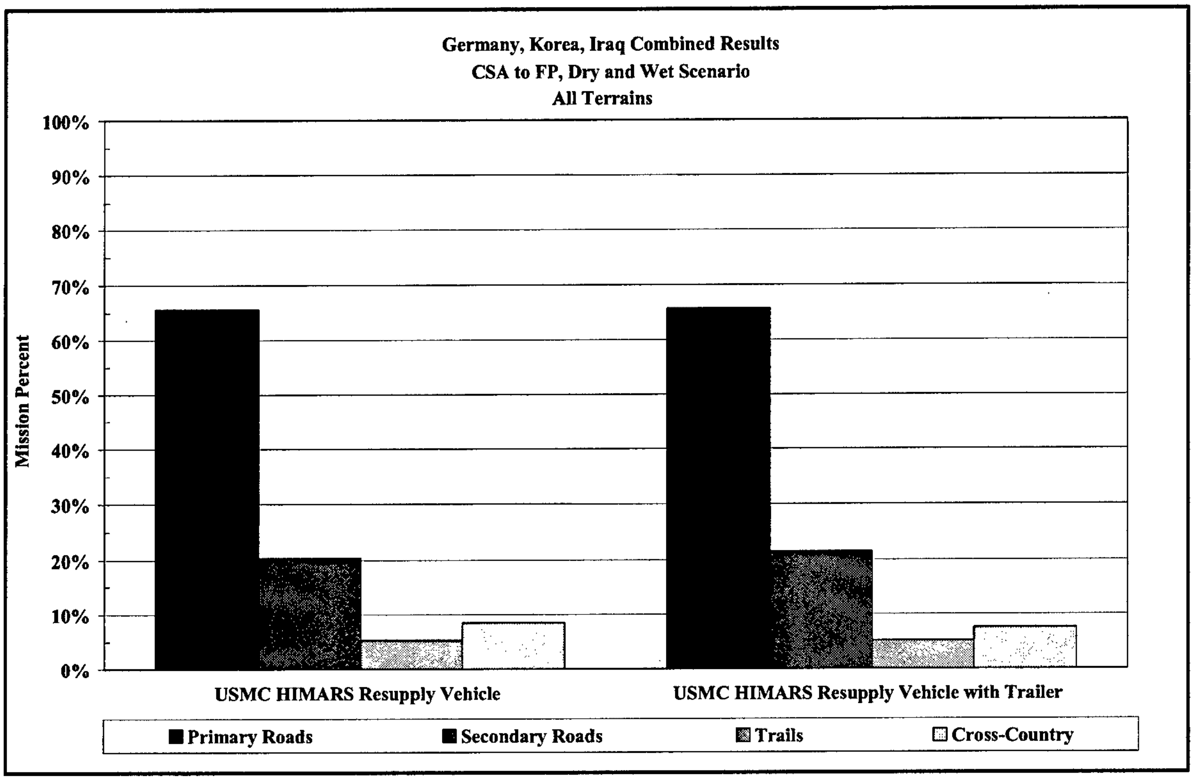

Figure C63. Combined area terrains encountered by the HIMARS vehicle operating from CSA to FP

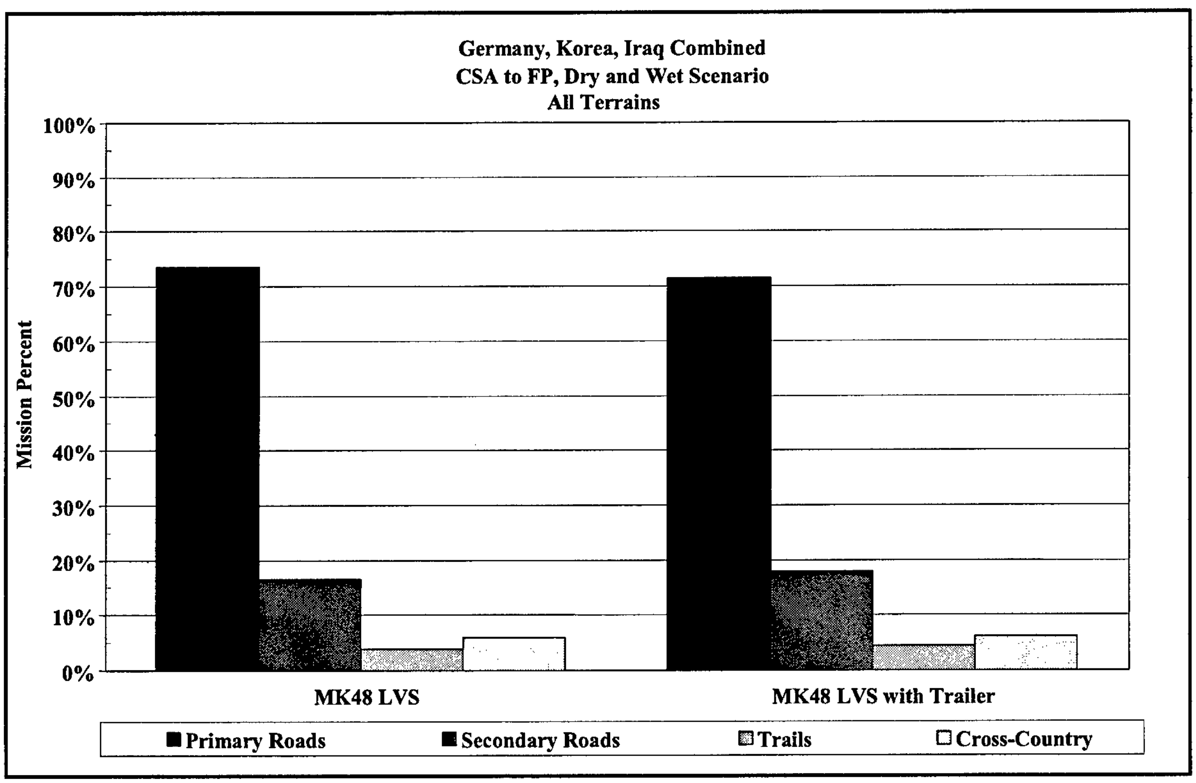

Figure C64. Combined area terrains encountered by the MK48 vehicle operating from CSA to FP

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14. ABSTRACT
The U.S. Army Engineer Research and Development Center (ERDC), Vicksburg, MS, conducted a vehicle mobility analysis for the U.S. Marine Corps (USMC) High Mobility Artillery Rocket System (HIMARS) to identify the different mission profiles the prime transporters (the USMC Medium Tactical Vehicle Replacement (MTVR) and the MK48-14 Logistics Vehicle System (LVS)) may encounter during worldwide deployment. The proposed mission profile evaluation program focused on using computer-based digital terrain and vehicle mobility models to determine the different terrain types the vehicle may encounter while deployed on missions in three representative climatic regions. The predicted mission profiles for the MTVR and LVS, with and without a M1095 trailer, were quantified to determine their relationship to standard mission profile descriptions. The TeleEngineering Toolkit was used to graphically plan and locate the potential HIMARS mission scenarios in the three regions. The NATO Reference Mobility Model (NRMM) was used to predict the mobility performance of the MTVR and LVS over these regions. The Route Analysis Routine was used to determine the fastest routes to the different storage areas based on the selected corridors of operation and on the NRMM vehicle mobility performance predictions. The Mission Severity Rating algorithms were used to quantify the different mission segments for comparison to standard mission levels and to determine the appropriate mission level for the study vehicles for each climatic region. These climatic region conclusions were combined to develop a worldwide mission profile for each vehicle configured with and without a trailer.

15. SUBJECT TERMS
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Mission Severity Rating

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